BIG ROCK NUCLEAR POWER STATION

EVACUATION TIME ESTIMATES

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1. INTRODUCTION

In a letter dated November 29, 1979, the U.S. Nuclear Regulatory Commission (NRC) requested all reactor operators to provide information on evacuation time estimates for specified zones in the vicinity of their nuclear power plants for both routine and adverse weather conditions. Other information concerning evacuation time estimates for "special facilities", was also requested in the NRC letter. A copy of this letter is attached as Appendix A. The purpose of this report is to provide a partial response to the NRC letter. Information collected and reviewed during the period January 7 to 18 was used for this evaluation and reporting effort.

This information was developed for areas within the 2-, 5-, and 10-mile radii of the Big Rock site. Subsequent to the November 29, 1979 letter, a second letter was sent to Consumers Power Company from the NRC. A copy of this letter dated June 13, 1980 is also included in Appendix A and indicates that the plume exposure EPZ is defined as the area within about a 5-mile radius of the Big Rock plant. Information on the area within 5 to 10 miles of the site has also be included as further background material.

The Emergency Operations Plan for Charlevoix County describes the interrelationship of the Big Rock Nuclear Plant personnel and state and local authorities in the event of emergency conditions. This plan has been reviewed for the purpose of providing information on established emergency procedures to protect populations within certain areas surrounding the Big Rock facility. This emergency response information was combined with data regarding area population distribution (estimated summer and winter populations) and local road network characteristics to estimate various times that an evacuation could take.

These evacuation time estimates are discussed in Section 5 and summarized on Table 9. Appendix A also includes correspondence with the Michigan Department of Transportation,

Traffic and Safety Division. The Department reviewed work performed and provided comments which are attached. Section 2 describes the spatial areas analyzed in the vicinity of the site. Estimates of vehicles to be evacuated are described in Section 3. Information on the local road network to be used during an evacuation is included in Section 4.

2. STUDY AREA

2.1 Townships within 2, 5, and 10 Miles

Figure 1 shows the county, township and city boundaries within the 10-mile radius. This radius falls mostly in Charlevoix County with a small portion in Emmet County.

- 2-Mile Radius. Charlevoix County (area includes portions of Hayes and Charlevoix Townships).

- 5-Mile Radius. Charlevoix County (area includes portions of Hayes and Charlevoix Townships and the City of Charlevoix, located at three to five miles southwest of the site). Charlevoix City, with a current permanent population of approximately 5,000 persons, is the largest population grouping in both the 0- to 5-mile and 0- to 10-mile radii. Other concentrations of populations are found near water bodies such as Lake Michigan and Lake Charlevoix.

- 10-Mile Radius. Charlevoix County (area includes all of Hayes and Charlevoix townships, and the City of Charlevoix, and portions of Norwood, Marion, Eveline, Bay and Evangeline townships). Smaller population groupings associated with unincorporated settlements or villages such as Ironton and Horton Bay also exist within the 10-mile radius. Boyne City with a projected 1980 population of approximately 4,000 persons, is located 12 miles southeast of the Big Rock Nuclear Plant.*

  Emmet County (area includes portions of Resort, and West Traverse Townships). The Cities of Petoskey,

*Boyne City was not included in the evacuation analysis.

with a current population estimated at 7,000, and Harbor Springs, with a population of about 2,000, are each respectively located approximately 10.5 miles east and east-northeast of the Big Rock Nuclear Plant.*

2.2 Sector Analyses

Spatial areas examined were within the 2-, 5-, and 10-mile radii of the reactor site. Figure 2 shows the study areas examined in this report. The 2-mile radius was analyzed as a single area (180° sector) while the areas within the 0- to 5-mile and 0- to 10-mile radii were divided into two parts for this evaluation (90° sectors).** The same study area sectors were examined for both an assumed summer fair-weather condition and winter adverse-weather condition. Sectors evaluated were established following a review of available population information, a review of maps of the local road network, and a limited field inspection. Appendix E contains maps which delineate the various sectors analyzed. The following is a brief description of the sectors analyzed.

Analysis Area	Distance Miles	22-1/2° Sectors	Description
1	0-2	ENE, E, ESE, SE, SSE, S, SSW, SW	Predominantly rural with some industry. Main evacuation routes include U.S. 31, Boyne City Road and Old U.S. 31
2	0-5	S, SSW, SW, WSW	Includes City of Charlevoix. Outside of City is predominantly rural. Main evacuation routes include U.S. 31, M-66, Boyne City Road, and Marion Center Road

*Petoskey and Harbor Springs were not included in the evacuation analysis.

**Approximately corresponding to the 90° and 180° sectors described in the NRC letter of 11/29/79. Note that only two 90° sectors exist since much of the area within 10 miles is over water.

Analysis Area	Distance Miles	22-1/2° Sectors	Description
3	0-5	ENE, E, ESE, SE, SSE	Predominantly rural with some industry. Seasonal residents are located along Lake Charlevoix. Main evacuation routes include U.S. 31, Boyne City Road and Pin Cherry Road.
4	0-10	S, SSW, SW, WSW	Between 5 and 10 miles is predominantly rural. Small communities at Ironton and Barnard. Seasonal residents along Lake Charlevoix. Main evacuation routes include U.S. 31, M-66, Barnard Road and Marion Center Road.*
5	0-10	NE, ENE, E, ESE, SE, SSE	Predominantly rural with seasonal residents along Lake Charlevoix and Walloon Lake. Sparcely populated area exists between Lake Charlevoix and the South Arm. Main evacuation routes include U.S. 31, Boyne City Road Intertown Road, Peninsula Road, and Ferry Road*.

* As noted on page one, the plume exposure EPZ is about 5 miles. Information on the area within 5 to 10 miles of the site has been included as further background material.

3. POPULATION DISTRIBUTION AND ESTIMATED VEHICLE DEMAND

Available population and related housing data were reviewed. These data provided the basis for estimating the potential number of vehicles involved in a general evacuation. Population and housing unit distribution data for 1980 for permanent residents, seasonal residents and daily transients were combined to obtain estimates of vehicles for a general evacuation analysis. In addition, some data on selected facilities having special evacuation needs were developed.

Since the study area has an influx of seasonal residents during the summer period, a vehicle demand estimate for a summer weekend condition was made and used for this evacuation time analysis. A second vehicle demand estimate was made for a winter weekday condition. This second demand estimate was also used to evaluate evacuation times under adverse weather conditions. A capacity approach was used to make both the summer weekend and winter weekday vehicle demand estimates. Vehicle demand estimates and information on special facilities are described below:

3.1 Population and Vehicle Estimates Associated with a General Evacuation

- Permanent and Seasonal Population

Table 1 provides a summary of the projected 1980 permanent and seasonal populations by township and city. This table also summarizes estimates of vehicles associated with permanent and seasonal populations.

Vehicle demand estimates included in Table 1 are based on numbers of seasonal and year-round dwelling units. These data were obtained through the Charlevoix and Emmet County Planning Offices and are believed to reflect current conditions (see Appendix F).

- Populations Associated with Major Facilities

Tables 2 through 7 provide summary information on several categories of facilities located within the 10-mile radius of the site. These categories include:

Table 2 Major Employers,

Table 3 Overnight Accommodations,

Table 4 Campgrounds and Selected Recreation Areas,

Table 5 Recreational Boating,

Table 6 Medical Related Facilities, and

Table 7 Educational Facilities.

Information on sector locations of these selected major facilities and, where possible, estimates of associated vehicle demand are included on these tables. Facility locations are keyed to sectors and shown on Figure 3.

- Populations Associated with "Special Events"

During the summer and fall periods, a number of "special events" take place in the Charlevoix area which result in short-term increases of transient populations. Major events noted include:*

1) Art Fair. Major event. Next Art Fair scheduled for August 1980. Throughout this day, persons arrive and depart from Charlevoix City (East Park). Total permanent and seasonal resident and daily transient population visiting this area throughout the event is roughly estimated at 30,000 persons.

*Charlevoix Chamber of Commerce, Ms. J. Merta.

2) Venetian Festival. Major event. Similar to Art Fair with respect to attendance and location.

3) Hobby Craft. Another major event scheduled for July 12, 1980 at East Park, City of Charlevoix. Total daily attendance is estimated at 10,000 persons.

4) Castle Farms Concert. Major music concerts scheduled for several weekends during the summer months. No schedule for 1980 is presently available. Persons arrive in the afternoon for concerts normally scheduled for evening hours. Peak population estimated at a previous concert was 18,000 persons. Castle Farms is located approximately 5-1/2 miles south-southwest of the plant, and two miles south of the City of Charlevoix, on Route 66.

5) Golf Tournament. Tournament is held annually at the Belvedere Golf Club (City of Charlevoix). Attendance is estimted at 200 golfers and a large spectator population.

6) Fall Color Cruises. Boat cruises in Lake Charlevoix and Lake Michigan occur during the autumn period. It is estimated that 200 to 300 persons per day attend the cruises which occur over a 5-day period.

7) National Sailboat Regatta. Scheduled for the summer of 1980, this event may involve 100 boats (or 200 to 300 persons).

Vehicles associated with these events were not included in the following estimates of vehicle demand, since they occur only on several days during the year.

- Vehicle Demand Estimates

The estimated summer (Figure 4) and winter (Figure 5) vehicle (private automobile) demand distributions were based on the following occupancy factors and estimates:

Summer Weekend Estimate	Winter Weekday Estimate
1. One vehicle per permanent residence (Table 1)	1. One vehicle per permanent residence (Table 1)
2. Two vehicles per seasonal residence (Table 1)	2. One vehicle for 50% of seasonal housing units (Table 1)
3. One vehicle per unit at accommodations such as motels (Table 3)	3. Same, but includes only facilities open year-round (Table 3)
4. One vehicle per campsite or other estimate for recreational areas (Table 4)	4. Camping not included
5. Major employers not included in estimate, weekend condition assuming fewer workers at place of employment	5. Major employers in area (Table 2), weekday condition assuming workforce at major employment locations
6. One vehicle per marina mooring or boat slip estimate (Table 5)	6. Recreational boating not included in estimate

The resultant vehicle demand distributions for the various 1980 population categories are included in Appendix B. Figures 4 and 5 combine individual vehicle demand estimates associated with permanent, seasonal and transient populations for assumed summer and winter conditions. The approach to estimating vehicle demand may result in some double counting of vehicles. These vehicle demands were used to estimate sector evacuation times between the point of notification to evacuate, and the point of confirmation that an evacuation has been completed. The method used to estimate general evacuation times is described in Section 5.3. A discussion of notification procedures, general evacuation times, status of

evacuation procedures for facilities with special needs, and possible confirmation procedures is also included in Section 5.

Several other sources of information were used to estimate vehicle demand. A field survey of housing units, conducted in the summer of 1979 by Consumers Power Company, was used to estimate the population and its sector distribution within four miles of the site. A copy of this survey is included as Appendix C. Venicle demand estimates and their distribution for the area between four and ten miles of the site were based on 1980 city and township population projections (see Table 1), and a review of U.S.G.S. and township plat maps.

3.2 Population and Vehicle Estimates Associated with Facilities Having Special Evacuation Needs

A number of facilities located within the 10-mile radius were identified which have special evacuation needs. For example, these facilities include the medical, (see Table 6), educational, (see Table 7), and other facilities requiring special consideration. Vehicle demands for these special facilities were not included in the summer and winter estimates associated with the general population (see Figures 4 and 5). Evacuation of special facilities would require the use of a combination of additional automobiles, buses, or emergency vehicles (ambulances). Evacuation of special facilities are addressed separately in Section 5.4.

4. ROAD NETWORK CHARACTERISTICS AND EVACUATION ROUTES

The road network utilized in the evacuation analysis is shown in Figure 6. An inventory of the physical and operational characteristics of the road network within the 10-mile radius of the Big Rock Nuclear Site has been developed. Results of the inventory are summarized in Table 8, which is keyed to Figure 6.

Segments of routes within the network links were driven and timed as part of the inventory process. Figure 6 also shows measured driving times for selected road segments. Field timings of links were taken on January 8th and 9th, 1980, when characteristic winter weather conditions prevailed, i.e., snow and wind. Driving times when roads are free of snow can be expected to be less than those recorded for such winter conditions. Although the times do not reflect a worst-case situation (e.g., most roads closed due to snow), they do represent a typical winter scenario.

The road network inventory information was used to calculate evacuation times for analysis areas. Evacuation routings for sectors analyzed are shown on figures included in Appendix E.

As described in Section 2, the 10-mile area surrounding the plant has an adequate number of excellent egress routes. ?1, Boyne City Road and M-66 are the major egress routes as they lead to reception areas identified in the Charlevoix County Emergency Operations Plan. In addition, these routes have higher vehicle capacities than the numerous secondary routes within the 10-mile study area. The majority of the study area is rural and the roadway network reflects this. The roads vary from asphalt/bituminous to gravel. The topography within the 10-mile radius is generally quite hilly resulting in steep grades on portions of some secondary roads.

5. EVACUATION TIMES

5.1 Summary

An analysis has been performed to estimate the time that might elapse for completing a public evacuation of each of the sector configurations shown on Figure 2. These estimates are for the time that would elapse from initial notification of the need to evacuate (Time period one, T-1) to the time that the defined sector evacuation is completed within the 0 to 2-, 0 to 5-, and 0 to 10-mile radii (Time period two, T-2), to the time special facilities are evacuated, if not completed within the general evacuation period (Time period three, T-3), and to the point in time that confirmation of evacuation has occured (Time period four, T-4).

The results of this analysis are shown in Tables 9and 10. An effort has been made to present information for both an assumed summer fair-weather condition, and a winter adverse-weather condition.

The following subsections elaborate on estimates, assumptions, and methods used to estimate notification time, general and special evacuation times, and confirmation time.

5.2 Assessment and Notification to Evacuate - Time Period One

An evaluation of the time periods associated with recognizing a general emergency condition, assessing off-site radiological consequences, and notifying off-site authorities and, if necessary, the general public, involves assumptions that stem from the emergency planning framework which has been established for the Big Rock Nuclear Plant. Such assumptions are based on the Big Rock Emergency Operation Plan arrangements and methods as they are currently conceived.

Annex B - Warning (Attachment 7, Nuclear Power Plant Emergency Response, page B15) of the Charlevoix County Emergency Operations Plan outlines actions to be implemented

by the "Warning Officer", based on the initial information of an accident at the Big Rock Nuclear Plant. These major notification time steps are as follows:

a) Activate the "EOC Activation Alert List", Attachment 3 of Annex B. A copy of the alert list is attached as Appendix G. This list includes telephone and radio telephone notification to various local agencies and several special facilities (i.e., hospitals and schools). This list includes the drawbridge in Charlevoix, which will be directed to remain in the down position, since it is part of the evacuation road network.

b) Provide available information to dispatch points in Emmet County.

c) Notify Deputy Emergency Services Coordinators in municipalities of the situation and advise to standby to support county operations.

d) Coordinate with the Emergency Public Information Office to determine the appropriate message to be used in pulic notification.

e) Based on the advice of those involved, warn the population of the affected sectors.

f) Alert managers of radio and television stations to be prepared to transmit Emergency Public Information messages as provided by the Public Information Officer.

g) Coordinate with Law Enforcement and Fire Services to extend public notification by sector, utilizing public address systems on emergency vehicles.

h) Follow-up with a door-to-door distribution of mass produced, detailed Emergency Public Information materials by Law Enforcement and Fire Service personnel, utilizing radiation detection devices and protective measures as appropriate.

i) Notify County Public Health to alert County Emergency Medical Services (EMS) for the possible need to move the infirm and disabled including mutual aid through the district health office. This will include assistance from adjoining county's EMS. List of the infirm receiving state assistance is available through the County Office of Social Services.

It is estimated that contacts on the alert list would be made within 10 to 30 minutes. This estimate is based on a test alert conducted by the Charlevoix County Sheriff's Office. Items b), c), and d) all involve activities which could take place simultaneously with item a) activities. Time estimates for these three items (b, c, and d) are therefore included within the 10- to 30-minute initial notification estimate.

Notification steps e) through i) would require additional time to implement. These steps include activities which extend public notification to sectors and assume a door-to-door type notification. Item ') includes notification of infirm and disabled persons. Notification time estimates for these five items (e through i) are shown below. The notification time (fair weather) estimate for the area within two miles was based on a field reconnaissance effort. This involved the EOC coordinator driving this area. Results of this effort were also discussed with the Charlevois County Sheriff's Department Staff. The other notification time estimates were also based on the driving time survey. A telephone alert list will be prepared to assist in notification of persons within the 2-mile radius of the plant. This list of calls would be broken down

and assignments made in order to facilitate this notification process. Personnel available on a 24-hour basis include staff of the Charlevoix County Sheriff's Department, Emmit County Sheriff's Department, Charlevoix Police and Fire Departments, (Petosky) State Police Post, East Jordan Police and Fire Departments, and (Charlevoix) U.S. Coast Guard Station. (Source: Mr. Earl Muma, EOC coordinator).

	Maximum Fair Weather Condition Estimate	Maximum Adverse Weather Condition Estimate
0 to 2 mile radius (Area 1)	1 hour	2 hours
0 to 5 mile radius (Areas 2 & 3)	3 hours	7 hours
0 to 10 mile radius (Areas 4 & 5)	4 hours	8 hours*

These time estimates assume approximately 50 support personnel would assist in the notification process, and that notification within the City of Charlevoix would be accelerated by the use of two police vehicles equipped with loud speakers for broadcast of an emergency condition. Assistance from East Jordan for notification of persons along the South Arm of Lake Charlevoix will occur. This support was assumed at a level of approximately ten persons. The times noted reflect primarily the use of standard passenger vehicles and some 4-wheel drive vehicles. A situation where roads were impassable due to snow or for other reasons, notification times could be extended.

Thus, it is estimated that the sector notification times for the 2-, 5-, and 10-mile radii would be:

	Fair Weather hrs:min - hrs:min	Advese Weather hrs:min - hrs:min
0-2 Miles (Area 1)	1:10 - 1:30	2:10 - 2:30
0-5 miles (Areas 2 & 3)	3:10 - 3:30	7:10 - 7:30
0-10 miles (Areas 4 & 5)	4:10 - 4:30	8:10 - 8:30*

* As noted on page one, the plume exposure EPZ is about 5 miles. Information on the area within 5 to 10 miles of the site has been included as further background material.

Notification times under fair-weather are about half those for an adverse-weather condition.

5.3 General Evacuation - Time Period Two

In order to determine the time needed to evacuate vehicles from the various analysis areas, roadway capacities must be determined.

Roadway capacity is expressed in vehicles per hour (v/h). Once the roadway capacities are known, vehicles can be routed through the network. Clear times will be much higher if the flow of vehicles on a roadway approaches its capacity.

Roadway capacities were determined by following procedures outlined in the Highay Capacity Manual.* Physical data for each roadway were needed before the capacities could be calculated. A field inspection of the majority of roads within 10 miles of the plant was undertaken to collect the necessary data. Table 8 presents the results of this investigation.

Capacity calculations are based on the assumption that each travel lane has a theoretical capacity of 2,000 v/h.** Modifications to this value are made based on the number of travel lanes, lane width, distance to nearest obstruction, worst traffic grade and the percentage of trucks on the roadway. Roadway capacity is increased with an increase in the lane width and number of travel lanes. If there is a sufficiently wide paved shoulder, an extra lane may be possible during an evacuation. This possibility was not included in the evacuation analysis.

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*Highway Research Board, Highway Capacity Manual, National Academy of Sciences, National Research Council, Special Report 87, 1965.

**See Appendix D.

An obstruction (guardrail, telephone pole, mailbox, etc.) at the inner edge of a roadway reduces capacity as drivers tend to slow down to avoid the obstruction. Where a paved or gravel shoulder was present, an obstruction was assumed to be present at the edge of the shoulder. Where no shoulder was present, an obstruction was assumed to be at the pavement edge, allowing for a more conservative capacity value.

It is not anticipated that heavy duty trucks will be used in an evacuation. The presence of large trucks results in a reduced roadway capacity. Under normal conditions, a significant number of trucks would not be expected on secondary roads. For conservatism, trucks were assumed to be present on the major highways (U.S. 31 and M-66). The percentage of trucks on these arterials was obtained from the 1978 Michigan Highways Sufficiency Rating.* The roadway grade is included in the capacity calculations where trucks are present. If an uphill grade is present on a roadway with trucks, the theoretical capacity will be reduced.

There are two signals within the 10-mile radius. One is located in downtown Charlevoix, and is functional all year round. The other signal is at the drawbridge in Charlevoix and only turns red when the bridge is up. In addition, there is a blinking beacon at the intersection of U.S. 31 and M-66 in Charlevoix. The Highway Capacity Manual contains a procedure for determining roadway capacity based on the green time of a signal. Appendix D contains sample calculations illustrating the methodology used to arrive at the intersection capacity, as well as the other roadway capacities.

Using the vehicle demand figures (see Figures 4 and 5), total projected auto demand by analysis area was determined. These areas are shown on Figure 2. Vehicles weere then assigned to the evacuation road network.

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*Michigan Department of State Highways and Transportation, Michigan Highways Sufficiency Rating, Report No. 153, 1978.

In assigning the identified vehicle demand to the road network, vehicles were apportioned to the evacuation route, previously identified, within or nearest to the major population center(s) within each sector or ring. In those cases where there was more than one route, population was split evenly among them, unless roadway capacities dictated a different apportionment. For example, if one road had a capacity significantly higher than another, it would receive more of the demand than would be indicated by a 50-50 split.

Cumulative vehicle demand was derived by adding to a road:

a) the demand estimated to be originating near it; and

b) all the demand from vehicles upstream which will be passing by on their way out of the evacuation area.

While demand at any one time on a road would not be equal to the total cumulative demand, it was assumed that all cars were on the network at the same time. The implication of this is that, from the time of first vehicle movement, the furthest downstream roads always have vehicles moving on them. This is important in the clear time calculations, as will be seen below.

Clear times were defined as the time to clear the evacuation area of all vehicles, starting from the point at which notification of the public is complete. The method used involved calculating clear times for all major evacuation routes. Not all routes necessarily start at the plant site; however, the longest routes tend to originate there.

For each road segment of a route, the time to clear the vehicles projected to use that route was calculated. In the case where demand was less than capacity, cars were assumed to travel with three seconds between them (3-second headway). The assumption of 3-second headway is considered reasonable, since it yields a maximum flow of only 1,200 vehicles per hour. This

implies that when demand is less than capacity, no matter how high the capacity, traffic flows at no more than 1,200 vehicles per hour. Most secondary roads in the area have a calculated capacity of about 1,200 vehicles per hour. In addition, a 3-second headway allows for a safe stopping distance.

For example, in a 2-mile evacuation, 125 vehicles will traverse the plant access road. Allowing three seconds for each vehicle, it would take about six minutes to clear the segment.

Where demand would exceed capacity, the calculated capacity was used as the maximum flow rate.* In this case, dividing demand by capacity gave an estimate of clear time for the segment. This method was used when demand exceeded capacity, since the roadway capacity was the constraining factor. The headway method was used when demand did not exceed capacity as the demand was the constraining factor.

After clear times for each link were calculated, it was necessary to determine route clear times. An imaginary last car was routed through the network and the clear time calculated for each evacuation route, by sectors, for both winter and summer scenarios. Table 10 lists the maximum calculated clear times for each evacuation route. The route clear times and vehicle demands for each analysis are shown on figures contained in Appendix E. The summer values are conservative as they include travel times obtained under adverse winter weather conditions. Capacity was not reached on any roadway east of the plant. Roadway capacity was reached in the City of Charlevoix, under summer vehicle demands. This is the reason for the much higher clear times for the western sectors.

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*This implies a time headway of 3,600/capacity seconds. Where capacity is greater than 1,200 vehicles per hour, this estimate yields time headways of less than the assumed free-flow 3-second headway.

The maximum clear times west of the plant assume a limiting capacity of 760 v/h at the signalized intersection in downtown Charlevoix. However, if point control were available at the intersection, the clear times would be reduced. Assuming the signal did not exist, the theoretical capacity would be 1,260 v/h. The resultant clear times would be 5 to 25 minutes less, depending on the evacuation route and time of year. Maximum clear times assuming point control at the downtown Charlevoix intersection are also shown on Table 10.

Several factors were not included in the analysis. There will be a queue where vehicles are leaving a parking lot or where vehicles cross intersections or turn into traffic. In addition, the model basically assumed no formal traffic control. Vehicles were routed along a route which would probably be taken under normal conditions. Some control is inherent in the model as vehicles were not allowed to travel towards the plant, even if a faster clear time could be realized.

A special note should be mentioned concerning the drawbridge on U.S. 31 in downtown Charlevoix. The evacuation analysis assumed the bridge to be in a down position. During the summer months, the bridge is opened every half hour between 6:00 AM and 6:00 PM. Between 6:00 PM and 6:00 AM, the bridge is opened as needed. During the winter months, the bridge is opened when necessary. The bridge operator is on the EOC activation list. In the event of an emergency, the bridge operator would be notified to keep the bridge down.

It should noted that there are less than 1,000 vehicles projected to use the bridge as an egress route. The majority of vehicles to be evacuated from the 0- to 5-mile and 0- to 10-mile raddi enter the network west of the drawbridge from the populated portions of Charlevoix.

It was assumed that during the time of notification, all external traffic (i.e., through traffic not included in demand estimates) will be cleared from the network, and roadblocks will be set up to prevent other traffic from entering. Traffic

control will be available to the extent that the above action can be taken, and to help minimize turning movement conflicts at intersections. Finally, even though demand will build up at the beginning, and taper off at the end of the evacuation, it is assumed that traffic flow is uniform during the evacuation. This maximizes delays and therefore clear times.

The number of vehicles in the summer analysis represents normal conditions. There are special events which occur during the summer. During the art fair there may be an influx of an additional 3,000 vehicles which, based on the U.S. 31 signalized intersection capacity, would result in an estimated clear time of five hours. Under special conditions such as this, control would be expected which would reduce the clear time significantly.

In an actual situation, it is reasonable to assume that the agencies and personnel responsible for conducting an orderly evacuation would adapt to actual conditions as they developed. It is beyond the capability of the simple analytical model to account for this kind of adjustment . For example, if it were observed that a particular route was becoming overly congested while traffic on another nearby route was light, traffic could be diverted from the more crowded to the less congested route. Similarly, traffic could be directed to use both lanes outbound on certain 2-lane roads to speed the evacuation process. Actions such as these would produce evacuation times which are faster than the times estimated in this analysis.

Consideration has been given to accomplishing an evacuation without the use of vehicles. Walking is a viable alternative to evacuating by vehicle. Assuming an able-bodied adult walking at 2.5 miles per hour from the plant via U.S. Route 31 either north or south to the 2-mile radius (about 2.5 miles), one hour would elapse. Continuing at the same rate to the 5 (about six miles) and 10 (about 11) mile radii via Route 31, the walking times would be about 2-1/2 and 4-1/2 hours, respectively. These walking times assume a fair weather condition.

5.4 Special Facilities Evacuation

- General Considerations

Notification to evacuate and confirmation of evacuation of areas will involve both individual residences as well as other populated facilities and locations. Total population in areas surrounding the plant will vary. Populations associated with selected facilities such as those noted in Tables 2 through 7 will be notified and evacuated as part of a general evacuation to the maximum extent possible. It is assumed that persons located at major employers (Table 2), overnight accommodations (Table 3) and most other facilities within an evacuation area will rely on passenger vehicles for transportation.

Facilities for which special evacuation requirements could exist include children's camps (Table 4), Charlevoix Area Hospital (Table 6) and educational facilities (Table 7). Evacuation of such facilities could require the use of a combination of additional transport vehicles. Infirm and handicapped personnel residing in the area may likewise require supplementary assistance and transportation. No major correctional facilities were identified in the study area. If persons were at the Charlevoix County Jail, they would be evacuated by the Charlevoix County Sheriff's Department personnel.

- Ambulance Demand

Emergency vehicles would be required if evacuation of the Charlevoix Area Hospital was required. The hospital would have the greatest concentration of persons with special evacuation needs. This facility is located approximately 5-miles southwest of the Big Rock Nuclear Plant in the City of Charlevoix. The 44-bed hospital has an estimated average occupancy of 27 in-patients. It is estimated that one-third of

these in-patients (9 persons) would require ambulance transportation to other hospitals.* Other patients and staff could be evacuated by private automobile in an emergency. Evacuating "special need" patients would be evaluated on a case-by-case basis by administrators and staff of the hospital. No estimate of emergency vehicle requirements for infirm or handicapped persons at other locations was made. Evacuation of persons with special needs will be coordinated through the Charlevoix County Sheriff's Department and EOC.

- School Bus Transportation

Evacuation of educational facilities (see Table 7) would require use of buses as a primary mode of transport. No educational facilities were identified within the 2-mile radius. Seven such facilities were identified within the 3- to 5-mile radii southwest of the Big Rock Nuclear Plant. One facility exists in Ironton, approximately seven miles south of the site. A total school related population (students and staff) is estimated at 1,800 persons in the 5-mile radius and within the City of Charlevoix. The largest student populations are associated with the three Charlevoix public schools (Charlevoix High School, Charlevoix Intermediate School, and Charlevoix Elementary School). No estimate of bus requirements was made.

Several camps were identified within the 10-mile radius. Three of these facilities, Mt. McSauba Day Camp (SW 2-3 miles), Camp Seagull (SE 6-7 miles), and Camp Daggett (SE 6-7 miles) accommodate populations of children when open. Supplementary transport could be required to evacuate these camps. No estimate of possible vehicle requirements for these camps was made as part of this reporting.

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* Source: Telephone communication, Mr. R. Krueger, Charlevoix Area Hospital. Munson Hospital, Turners City, located 55 to 60 mies from the Charlevoix facility is the closest major medical care facility in this region.

It is assumed that evacuation of educational facilities and camps would be directed by administrators and staff at these facilities. Additional transportation, if required, would be coordinated through the Charlevoix Sheriff's Department and EOC.

- Evacuation of Boaters

Recreational boating and fishing occurs in the area. Notification and assistance in evacuation and confirmation of evacuation of boats or major water bodies (i.e., Lake Michigan and Lake Charlevoix) would be directed by Charlevoix County Sheriff's Department. Available support from the the Michigan Department of Natural Resources, Marine Division may be provided. Coast Guard and the Department of Natural Resources Stations exist in the City of Charlevoix, approximately 4-1/2 miles southwest of the plant. Evacuation of persons from other water bodies in the area would be undertaken as part of the general evacuation. Table 5 lists major docking areas within the 10-mile radius.

- Evacuation During "Special Events"

A number of "special events" occur in the Charlevoix area during the summer and fall periods. Major events identified which result in large increases in population for a number of days during these periods are briefly described in Section 2.

The Charlevoix County Sheriff's Office and EOC will coordinate notification and evacuation of persons associated with special events. Notification would likely include the use of police vehicle loud speakers.

5.5 Confirmation of Evacuation

Confirmation of an evacuation implies a thorough review of areas notified. Section 5.2 provides best estimates of notification time for fair and adverse weather conditions. It

is simply assumed that confirmation times would be roughly comparable to notification time estimates. Confirmation time is, therefore, estimated as follows:

	Maximum Fair Weather hrs:min - hrs:min	Maximum Advese Weather hrs:min - hrs:min
0-2 miles (Area 1)	1:10 - 1:30	2:10 - 2:30
0-5 miles (Areas 2 & 3)	3:10 - 3:30	7:10 - 7:30
0-10 miles (Areas 4 & 5)	4:10 - 4:30	8:10 - 8:30*

Times noted are for entire areas within the 2-, 5-, and 10-mile radii. Confirmation times for smaller areas (i.e., 90° sectors) would be less than those reported above.

Confirmation would be undertaken by appropriate federal, state and local authorities. The type of confirmation employed will be based on a review of the emergency situation as it exists. A general review of the evacuated area would be followed by more detailed confirmation efforts, such as door-to-door type checking again based on prevailing emergency conditions.

5.6 Total Evacuation Time

Emergency evacuation involves:

- notification as described in Section 5.2 whereby broadcast of a general emergency is followed by door-to-door type notification,
- evacuation including the evacuation of facilities and persons with special needs, and
- confirmation that evacuation is complete.

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* As noted on page one, the plume exposure EPZ is about 5 miles. Information on the area within 5 to 10 miles of the site has been included as further background material.

Some time overlap between these three activities is likely to occur in an emergency requiring evacuation as a protective measure. This overlap results in conservative total evacuation times, if the times to complete the three activities are added together. These totals assume that evacuation of persons with special needs occurs within the notification, general evacuation, and confirmation time periods.

Estimates for notification and confirmation (see Sections 5.2 and 5.5) were not based on a detailed analysis. These estimates were provided by the Director of the Charlevoix County Emergency Operations Center in consultation with Charlevoix County Sheriff's Office personnel. The notification and confirmation times presented are simply assumed to reflect maximum times required to undertake door-to-door type notification and confirmation with about 50 persons. The use of additional warning systems beyond those that presently exist could reduce notification and confirmation time estimates.

Following is a brief summary of evacuation time estimates for fair- and adverse-weather scenarios. These were obtained by summing the notification, general evacuation, and confirmation time estimates.

- Fair Weather Scenario

It is estimated that notificaton and general evacuation of the area within 2-miles of the plant could require 1-1/2 to 2 hours. Including confirmation, this time may increase to approximately 3 hours for the assumed fair-weather scenario. Estimated notification and general evacuation of the 0- to 5-mile radius is 5 hours. Total time would increase to about 8 to 8-1/2 hours with confirmation included. Combined notification and evacuation time for the areas within the 0- to 10-mile radius is estimated at 4-1/2 to 6 hours.* The confirmation period increases this estimate by 4-1/2 hours.

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* As noted on page one, the plume exposure EPZ is about 5 miles. Information on the area within 5 to 10 miles of the site has been included as further background material.

- Adverse Weather Scenario

The total evacuation time for area 1 (within the 2-mile radius) is approximately 5 hours. Total times for the 0- to 5-mile and 0- to 10-mile* areas are 16 hours and 18-1/2 hours, respectively.

* As noted on page one, the plume exposure EPZ is about 5 miles. Information on the area within 5 to 10 miles of the site has been included as further background material.

TABLES

TABLE 1

POPULATION & VEHICLE DEMAND ESTIMATES

	1970 Households (Perm.)	1970 Households (Seas.)	1970[1] Persons per Household	Projected[7] 1980 Population (Perm.)	Projected[7] 1980 Population (Seas.)	Total 1980 Permanent & Seasonal	Estimated Number of Vehicles: 1980 Permanent ÷ Avg. Household x 1 Vehicle/Unit	Estimated Number of Vehicles: 1980 Seasonal[12] Population ÷ 3.5 Winter	Estimated Number of Vehicles: 1980 Seasonal[12] Population ÷ 3.5 Summer	Total Estimate Permanent Resident & Seasonal Vehicle Demand (Summer)
Charlevoix County[3][11]										
Charlevoix (City)[9]	1,108	333[5]	3.09	4,927	1,458	6,385	1,595	(209)	834	2,429
Charlevoix Township	221	104[5]	3.26	1,008	455	1,463	309	(65)	260	569
Hayes Township	211	102[6]	3.35	988	446	1,434	295	(63)	254	549
Marion Township	190	29[6]	3.62	972	128	1,100	268	(19)	74	342[8]
Norwood Township	89	35[6]	3.65	455	154	609	125	(22)	88	213
Bay Township	126	169[6]	3.62	570	741	1,311	158	(106)	224	382
Evangeline Township	139	81[6]	3.17	550	350	900	174	(50)	200	374
Eveline Township	270	355[6]	3.10	1,046	1,554	2,600	115	(222)	888	1,003
Emmet County										
Resort Township	1,009		3.27[2]	1,430[4]	200[4]	1,630	437	(29)	114	551
West Traverse Township (portion within 10 mile radius)				=29[10]	=29[10]	58[10]	29	(15)[10]	58	87

[1] U.S. Census population source

[2] State average persons per household, 1970. U.S. Census

[3] Planning Department, Charlevoix County - John Harris

[4] Planning Department, Emmet County - Max Putters

[5] 1970 Census of Housing Source

Footnotes continued on next page.

(6) 1972-1973 Housing Survey, Charlevoix County Planning Department.

(7) Table X, Projected Population 1980-90, by Areas, Charlevoix County Comprehensive Plan.

(8) Estimate of vehicles 0 to 4 miles for seasonal and year round was estimated from field survey work completed by Consumers Power Co. during the summer of 1979. The survey identified location and number of total units within the 4 mile radius from the plant. An estimate of seasonal and permanent units was made and based on the ratio of seasonal to permanent units projected for 1980, (i.e. 295 permanent + 127 seasonal = 422 units or about 30% of total units in Hayes Township being grouped as seasonals. Also within 422 - (0 to 4 mile total units of ≈ 288) = ≈ 134 units in other areas of Hayes beyond 5 miles. Distribution of units for the 4 to 5 mile radius was estimated from counts of structures indicated on the most recent U.S.G.S. map. The map indicates an additional 70 total structures within the 4 to 5 mile radius in Hayes. Thus it is estimated that ≈288 units exist within 0 to 4 miles, 70 structures within 4 to 5 miles and an additional 64 units within the remaining portions of Hayes beyond the 5 mile radius. A ratio of 70% permanent to 30% seasonal was used in estimating vehicle demand.

(9) The city of Charlevoix is located within the 5 mile radius. It was estimated that ≈ 25 to 30% of the towns population is within 3 to 4 miles and 70% within 4 to 5 miles. It is estimated that 1478 permanent and 437 seasonal residents are in the 3 to 4 mile radius and 3449 permanent and 1,021 seasonal residents are found in the approximate 4 to 5 mile radius.

(10) Estimated by counting dots on U.S.G.S. map (Bay Shore quadrangle). Assumes 50% seasonal and 50% year round units. Numbers reflect dwelling units not population.

(11) Appendix E includes portions of Comprehensive Plan describing historical population trends and projections of growth for Charlevoix County.

(12) Assumption of 1 vehicle for 50% of all seasonal dwelling units during Winter.
Assumption of 2 vehicles for all seasonal dwelling units during Summer.

TABLE 2

MAJOR EMPLOYERS WITHIN 10 MILES OF THE BIG ROCK NUCLEAR PLANT

Map Code	Name	Address and Telephone	Sector Location	Estimated No. of Employees	Notes
E1	Lexalite Corp. of Charlevoix	N. U.S. 31 Charlevoix 547-6584 or 547-6550	ENE/0-1	110 (≈70 day shift)	3 shifts
E2	Leitz Industries	N. U.S. 31 Charlevoix 547-2891	E/0-1	7	
E3	Will-Flow Corp.	Petoskey Rd. Charlevoix 547-6545	SW/2-3	60	2 shifts
E3	Charlevoix Manufacturing Co.	400 Martin Rd. Charlevoix 547-4451	SW/2-3	32	
E3	Hufford Industries	Petoskey Ave. Charlevoix 547-9921	SW/2-3	34	Swing shift
E3	CRE North Bar Beverage Control	U.S. 31 N. Charlevoix 547-4459	SW/2-3	10	
E3	Charlevoix Products	Industrial Blvd. Charlevoix 547-4049	SW/2-3	N.A.	
E4	Freedman Artcraft Engineering Corp.	S. U.S. 31 Charlevoix 547-6501	SW/5-6	151	1 shift 4 day week

N.A. Not Available

Source: Charlevoix Chamber of Commerce, Ms. J. Merta

TABLE 2

MAJOR EMPLOYERS WITHIN 10 MILES OF THE BIG ROCK NUCLEAR PLANT

Map Code	Name	Address and Telephone	Sector Location	Estimated No. of Employees	Notes
E5	Hoskins Manufacturing Co.	M-66 Charlevoix 547-9411	SSW/5-6	85	3 shifts
E6	American Mold Engineering Co.	S. Old M-66 Charlevoix 547-6578	SW/4-5	88	3 shifts (only 2 or 3 on 2nd & 3rd shifts)
E7	Medusa Cement Co.	Bells Bay Rd. Charlevoix 547-9971	SW/5-6	112	7 days a week, 24 hrs./day
E8	Penn-Dixie Ind.	Charlevoix Rd. Petoskey 347-2531	E/8-9	190	
E9	U.S. Air Force Detachment 61st CEG	Townline and Martinchek Rds. Bayshore 347-8731	E/5-6	77	
E3	Weather Shield Sports Equipment, Inc.	Petoskey Rd. Rt#3 Box 227 547-6534	SW/2-3	75	1 shift
E10	Midwest Ind.	Stover Rd. 547-4073	SSW/4-5	25	
E11	Wojan Aluminum	Stover Rd. Box 91 547-6545	SSW/4-5	28	

TABLE 2

MAJOR EMPLOYERS WITHIN 10 MILES OF THE BIG ROCK NUCLEAR PLANT

Map Code	Name	Address and Telephone	Sector Location	Estimated No. of Employees	Notes
E12	Impac Tool Co.	401 W. Carpenter	SW/5-6	10	
E13	Charlevoix Machine Products	Norwood Rd. 547-4291	SW/5-6	10	
E14	Big Rock Nuclear Plant		E/0-1	125	Source: Milton Jury, Consumer Power Co.

TABLE 3

ACCOMMODATIONS (Guest Houses, Hotels, Motels, Cottages)
within 10 Miles of the Big Rock Nuclear Plant

Map Code	Name	Address and Telephone	Sector Location	Estimated No. of Vehicles	Yearly Schedule	Number of Units
A1	North Star Motel	1409 Bridge St. Charlevoix 547-2344	SW/4-5	12	All year	12 units
A1	Silver Birch Motel	South U.S. 31 Charlevoix 547-6601	SW/4-5	8	Summer only	8 units
A1	Sunset Lodge	W. Dixon Ave. Charlevoix 547-9216	SW/4-5	10	Summer only	10 units
A1	Charlevoix Hotel	206 Antrim Charlevoix 547-2861	SW/4-5	10	All year	units
A2	Alray Cottages	M-66 Ironton 547-2006	S/7-8	10	All year (ice fishing)	10 units
A3	The Lodge	U.S. 31N Charlevoix 547-6565	SW/4-5	40	All year	40 units
A3	Weathervane Terrace	U.S. 31 Charlevoix 547-9955	SW/4-5	36	All year	36 units
A1	Airport Motel	South U.S. 31 Charlevoix 547-9080	SW/4-5	11	Summer	11 units

Source: Charlevoix Chamber of Commerce, Ms. J. Merta.

TABLE 3

ACCOMMODATIONS (Guest Houses, Hotels, Motels, Cottages)
within 10 Miles of the Big Rock Nuclear Plant

Map Code	Name	Address and Telephone	Sector Location	Estimated No. of Vehicles	Yearly Schedule	Number of Units
A1	Archway Motel	S. Bridge St. Charlevoix 547-2096	SW/4-5	13	All year	13 units
A1	The Capri Motel	U.S. 31 Charlevoix 547-9224	SW/4-5	17	Summer only	17 units
A4	Charleboyne Motel	Boyne City Rd. Charlevoix 547-9340	SSW/2-3	8	Summer only	8 units
A1	Colonial Motel	U.S. 31 S. Charlevoix 546-6637	SW/4-5	11	Summer only 5/1-11/1	11 units
A1	Villa Moderne	S. Bridge St. Charlevoix 547-2578	SW/4-5	8	All year	8 units
A5	Wayside Motel & Cabins	Petoskey Rd. Charlevoix 547-2192	SW/2-3	27	Summer only	15 cabins 12 rooms
A5	Golf View Motel	Petoskey Rd.	SW/3-4	25	Summer only May-Oct.	25 units
A6	Valkommen	113 Michigan	SW/3-4	10	Summer only June-Sept.	10 units

TOTAL (all year): 141
(summer only): 115
256

TABLE 4

CAMPGROUNDS AND SELECTED RECREATIONAL AREAS
within 10 Miles of the Big Rock Nuclear Plant

Map Code	Name	Address and Telephone	Sector Location	Number of Campsites	Estimated No. of Vehicles	Information Source
C1	Nine Mile Point Park	U.S. 31 N Hayes Twnshp. 547-6740	ENE/2-3	50	50	Charlevoix Chamber of Commerce Ms. J. Merta
C2	Uhrick's Modern Camp	U.S. 31 Charlevoix 547-4285	SW/3-4	30	30	Charlevoix Chamber of Commerce Ms. J. Merta
C3	Windmill Campground	Boyne City Rd. Hayes Twnshp. 547-2746	SE/6-7	(500 acres) ≈250	250	Estimate-not confirmed with operators of campground
C4	Open Gate Campground	Wickersham Rd. Charlevoix 547-4772	S/8-9	(160 acres) ≈100	100	Telephone Communication (owner's wife)
C5	Fisherman's Island State Park (formerly Bells Bay Campground)	Bells Bay Rd. Charlevoix	WSW/5-6	41	41	Charlevoix Chamber of Commerce Ms. J. Merta
C6	Whiting County Park	M-66 Eveline Twnshp.	SSE/9-10	40	40	Charlevoix Chamber of Commerce Ms. J. Merta
C7	Young State Park	Boyne City Rd. Evangeline Twnshp.	SE/10+	296	296	Charlevoix Chamber of Commerce Ms. J. Merta

TABLE 4

CAMPGROUNDS AND SELECTED RECREATIONAL AREAS*
within 10 Miles of the Big Rock Nuclear Plant

Map Code	Name	Address and Telephone	Sector Location	Number of Campsites	Estimated No. of Vehicles	Information Source
C8	State Rest Area	U.S. 31 Hayes Twnshp.	ENE/0-1	0 (no overnights)	20	Charlevoix County Emergency Services Office Earl Muma
C9	Lake Michigan Beach	Charlevoix	SW/4-5	0 (no overnights)	~25	Charlevoix County Emergency Services Office Earl Muma
C9	Depot Beach	Charlevoix	SW/4-5	0 (no overnights)	~50	Charlevoix County Emergency Services Office Earl Muma
C9	Ferry Ave. Beach	Charlevoix	SW/4-5	0 (no overnights)	~100	Charlevoix County Emergency Services Office Earl Muma
C10	Mt. McSauba Day Camp		SW/2-3	(day camp)	*	
C11	Camp Seagull, Inc.	Lake Charlevoix 547-6556	SE/6-7	179 children	*	Charlevoix Chamber of Commerce Ms. J. Merta
C12	Camp Daggett	Walloon Lake	SE/6-7	100 children	*	Charlevoix Chamber of Commerce Ms. J. Merta

TABLE 4

CAMPGROUNDS AND SELECTED RECREATIONAL AREAS*
within 10 Miles of the Big Rock Nuclear Plant

Map Code	Name	Address and Telephone	Sector Location	Number of Campsites	Estimated No. of Vehicles	Information Source
C-13	Charlevoix Girl Scout Camp	Marion Center Road	SW/5-10	(no estimates)	*	Charlevoix County Emergency Services Office Earl Muma

*Transportation for evacuation will be coordinated by the EOC coordinator, notification will be by telephone or police vehicle.

TABLE 5

RECREATIONAL BOATING within 10 Miles of the Big Rock Nuclear Plant

Map Code	Name	Address	Sector Location	Number of Moorings & Slips	Estimated No. of Vehicles	Information Source
B1	Irish Marina	Stover Rd. Charlevoix	SW/4-5	150	150	Telephone communication Irish Marina employee
B1	Bellinger Marina	125 Belvedere Charlevoix	SW/4-5	~10	10	Charlevoix Chamber of Commerce Ms. J. Merta
B1	Fairport Marina	307 Belvedere Charlevoix	SW/4-5	~10	10	Charlevoix Chamber of Commerce Ms. J. Merta
B2	Ironton Ferry Landing	Ironton	S/7-8	~10	10	Charlevoix Chamber of Commerce Ms. J. Merta
B1	Municipal Marina	Charlevoix	SW/4-5	48	48	Charlevoix Chamber of Commerce Ms. J. Merta

TABLE 6

MEDICAL RELATED FACILITIES within 10 miles of the Big Rock Nuclear Plant

Map Code	Name	Address and Telephone	Sector Location	Population Number of Beds	Population Staff	Information Source
M1	Charlevoix Area Hospital	Lake Shore Dr. Charlevoix 547-4024	SW/4-5	44	30-50	Mr. Dick Krueger,[1] hospital administrator, (547-4024)
M2	Home for the Elderly	Maple Grove Rd. Charlevoix 347-1728	ESE/3-4	6	2	Mr. Bert Southwood,[2] operator

(1) Average estimated occupancy is 27 in-patients. Thus the estimate of ambulatory patients is 27-44. It is roughly estimated that one-third of such patients would require special emergency vehicle transport while the remaining two-thirds may be transported by passenger vehicles. These requirements would vary with in-patients' needs. Two ambulances are stationed at the Fire Department (City Hall) and other services are available in Petoskey. Patients requiring life support services or critical care would be transferred to Munson Hospital in Travis City. Those requiring less intensive care would be transferred to the Grandview facility in East Jordan. A best estimate made by (Mr. R. Krueger, 3/21/80), a hospital administrator, of time required to evacuate the Hospital following notification is one to three hours and assumes that adequate transportation is available.

(2) Facility operates presently as a family unit with less than 20 staff and residents. None presently require the use of emergency vehicles for evacuation.

TABLE 7

EDUCATIONAL FACILITIES within 10 Miles of the Big Rock Nuclear Plant

Map Code	School Name & Address	Grades	Sector Location	(A) No. of Students	(B) No. of Teachers/ Staff	Total (A+B)	Information Source
S1	Charlevoix High School Garfield St. Charlevoix 547-6491	9-12	SW/4-5	591	33	624	Secretary at Charlevoix Public Schools - number of students and faculty Mr. Vince O'Lach (1)
S2	Charlevoix Middle School Grant St. Charlevoix 547-4407	6-8	SW/4-5	387	22	409	Secretary at Charlevoix Public Schools - number of students and faculty Mr. Vince O'Lach (1)
S3	Charlevoix Elementary School Division St. Charlevoix 547-4361	1-5	SW/3-4	592	27	619	Secretary at Charlevoix Public Schools - number of students and faculty Mr. Vince O'Lach (1)
S2	St. Mary School 1005 Bridge St. Charlevoix 547-9441		SW/4-5	68	8	76	Sister Agnes Mary St. Mary School
S1	Bergman Center 201 E. Garfield Charlevoix 547-2979	Handi-capped	SW/4-5	20-30	8	38	Mr. Ken Brill (2)

(1) It is expected that evacuation of these facilities will be to other educational facilities in East Jordan.

(2) No plan for emergency evacuation exists. He explained that the facility has one van that accommodates 15 persons, thus some assistance and transportation would be required during an evacuation.

TABLE 7

EDUCATIONAL FACILITIES within 10 Miles of the Big Rock Nuclear Plant

Map Code	School Name & Address	Grades	Sector Location	(A) No. of Students	(B) No. of Teachers/ Staff	Total (A+B)	Information Source
S2	Charlevoix Montessori Children's House 101 State Charlevoix 547-2471	Pre-School	SW/4-5	23	2	25	Ms. K. Donovan
S4	Charlevoix Trainable School Ironton	Handi-capped	S/7-8	12	2	14	Ms. Pat Taylor 547-9947
S2	Charlevoix Co-op Nursery School (held at the Public Library)	Pre-School	SW/4-5	N.A.	N.A.	N.A.	N.A.

N.A. Not Available

TABLE 8

SUMMARY OF ROAD NETWORK CHARACTERISTICS

0-10 Miles, Big Rock Plant

Link No.	No. of Travel Lanes	Lane Width (ft)	Paved Shoulder Width (ft)	Distance to Nearest Obstruction (ft)	Worst Traffic Grade (%)	% Trucks	Link Capacity (v/h)
1[(a)]	2	9	6	6	4	5	760
2	4	9	0	0	4	5	2440
3	2	9	6	6	2	5	1445
4	2	9	6	6	2	6	1430
5	2	9	0	0	6	0	1160
6	2	9	0	0	2	0	1160
7	2	9	0	0	6	0	1160
8	2	9	0	0	4	0	1160
9	1-2	6-8	0	0	6	0	1160
10	2	10	0	3	4	0	1540
11	2	10	0	3	4	0	1540
12	2	10	0	0	2	0	1240
13	2	9	0	0	6	0	1160
14	2	10	0	3	6	0	1540
15	2	10	0	3	4	0	1540
16	2	9	0	0	4	0	1160
17	2	9	0	0	4	0	1160
18	2	9	0	0	4	0	1160
19	2	9	0	0	4	0	1160
20	2	10	6	6	2	6	1525
21	2	9	0	0	6	0	1160

(a) Capacity based on signalized intersection. Capacity will be 1260 v/h if there was point control at the intersections.

TABLE 8

SUMMARY OF ROAD NETWORK CHARACTERISTICS

0-10 Miles, Big Rock Plant

Link No.	No. of Travel Lanes	Lane Width (ft)	Paved Shoulder Width (ft)	Distance to Nearest Obstruction (ft)	Worst Traffic Grade (%)	% Trucks	Link Capacity (v/h)
22	2	9	0	0	6	0	1160
23	4	9	0	0	2	5	2660
24	2	9	6	6	2	6	1430
25	2	9	0	6	2	8	1415
26	2	9	0	0	2	0	1160
27	2	9	6	6	2	0	1520
28	2	9	5	5	4	6	1215
29	2	9	0	3	4	8	1095
30	2	9	0	0	4	0	1160
31	2	9	0	0	4	0	1160
32	2	9	0	0	4	0	1160
33	2	9	0	0	4	0	1160
34	2	9	0	0	4	0	1160
35	2	9	0	0	6	0	1160
36	2	9	0	0	4	0	1160
37	2	9	0	0	4	0	1160
38	2	9	0	0	4	0	1160
39	2	9	0	0	2	0	1160
40	2	9	0	3	4	0	1440
41	2	9	0	0	4	0	1160
42	2	9	0	0	4	0	1160

TABLE 8

SUMMARY OF ROAD NETWORK CHARACTERISTICS

0-10 Miles, Big Rock Plant

Link No.	No. of Travel Lanes	Lane Width (ft)	Paved Shoulder Width (ft)	Distance to Nearest Obstruction (ft)	Worst Traffic Grade (%)	% Trucks	Link Capacity (v/h)
43	2	9	0	0	4	0	1160
44	2	9	0	0	2	0	1160
45	2	9	0	0	4	0	1160
46	2	10	1	0	4	0	1240
47	2	9	0	0	4	0	1160
48	2	9	0	0	4	0	1160
49	2	9	0	0	4	0	1160
50	2	9	0	0	2	0	1160
51	2	9	0	0	4	0	1160
52	2	9	0	0	4	0	1160
53	2	9	0	0	2	0	1160

TABLE 9

SUMMARY OF EVACUATION TIME ESTIMATES IN MINUTES

Analysis Area[1]	Radii	Summer Weekend: Fair Weather				Winter Weekday: Adverse Weather			
		Notification[2][3] T_1	General Evacuation[2] T_2	Special Facilities T_3	Confirmation[2] T_4	Notification[2][3] T_1	General Evacuation[2] T_2	Special Facilities T_3	Confirmation[2] T_4
1	0-2 mi	70-90	12	(4)	70-90	130-150	14	(4)	130-150
2	0-5 mi	190-210	83	(4)	190-210	430-450	76	(4)	430-450
3	0-5 mi	190-210	28	(4)	190-210	430-450	26	(4)	430-450
4	0-10 mi	250-270	95	(4)	250-270	490-510	75	(4)	490-510
5	0-10 mi	250-270	72	(4)	250-270	490-510	75	(4)	490-510

NOTE: BECAUSE (a) EVACUATION NOTIFICATION AND CONFIRMATION TIME ESTIMATES ARE FOR THE ENTIRE 0 TO 5 AND 0 TO 10 MILE RADII AND (b) ALSO SINCE OVERLAP IN NOTIFICATION, GENERAL EVACUATION AND CONFIRMATION ACTIVITIES WOULD MOST LIKELY OCCUR, THE ADDITION OF THE ABOVE TIME ESTIMATES COULD RESULT IN CONSERVATIVE EVACUATION TIME ESTIMATES FOR SUMMER AND WINTER SCENARIOS. THIS ASSUMES EVACUATION OF PERSONS WITH "SPECIAL NEEDS" (T_3) OCCURS CONCURRENTLY AND WITHIN THIS SAME TOTAL EVACUATION PERIOD (T_1, T_2 & T_3).

(1) See Figure 2 for analysis area location.

(2) Notification and confirmation times for the 0-5 mile and 0-10 mile distances represent the times for the entire 5-mile and 10-mile radius areas, not for the analysis areas, which are smaller.

(3) This represents the time estimate for notifying the last persons in the sector by door-to-door methods.

(4) Sufficient information is not available at this time to permit estimates for all special facilities in each analysis area.

TABLE 10

GENERAL EVACUATION CLEAR TIME ESTIMATES

Analysis Areas	Radii	Evacuation Routes	Summer Clear Time Estimates (Minutes)	Winter Clear Time Estimates (Minutes)
1	0-2 mi	U.S. 31 North	12	14
		U.S. 31 South	8	7
		Boyne City Rd. South	6	6
		Old U.S. 31	4	4
2	0-5 mi	U.S. 31 South	83* (78)	76* (68)
		M-66	83* (68)	76* (52)
		Marion Center Rd.	83* (68)	76* (52)
		Boyne City Rd.	13	10
3	0-5 mi	U.S. 31 North	28	26
		Boyne City Rd. South	9	8
		Boyne City Rd. North	8	7
		Pin Cherry Rd.	7	6
4	0-10 mi	U.S. 31 South	90* (85)	70* (60)
		Barnard Rd.	90* (85)	70* (60)
		Marion Center Rd.	90* (75)	70* (45)
		M-66	95* (75)	75* (50)
		Boyne City Rd. South	13	10
5	0-10 mi	U.S. 31 North	70	75
		Intertown Rd.	13	12
		Boyne City Rd. South	72	32
		Boyne City Rd. North	8	7
		Peninsula Rd.	21	12
		Ferry Rd.	22	13
		U.S. 131 (portion of West Traverse)	10	10

*Represent values based on green time of signal on U.S. 31 in downtown Charlevoix. Values in parenthesis represent approximate clear time if there were point control at the intersection resulting in the theoretical capacity of the link being 1260 v/h instead of 760 v/h.

FIGURES

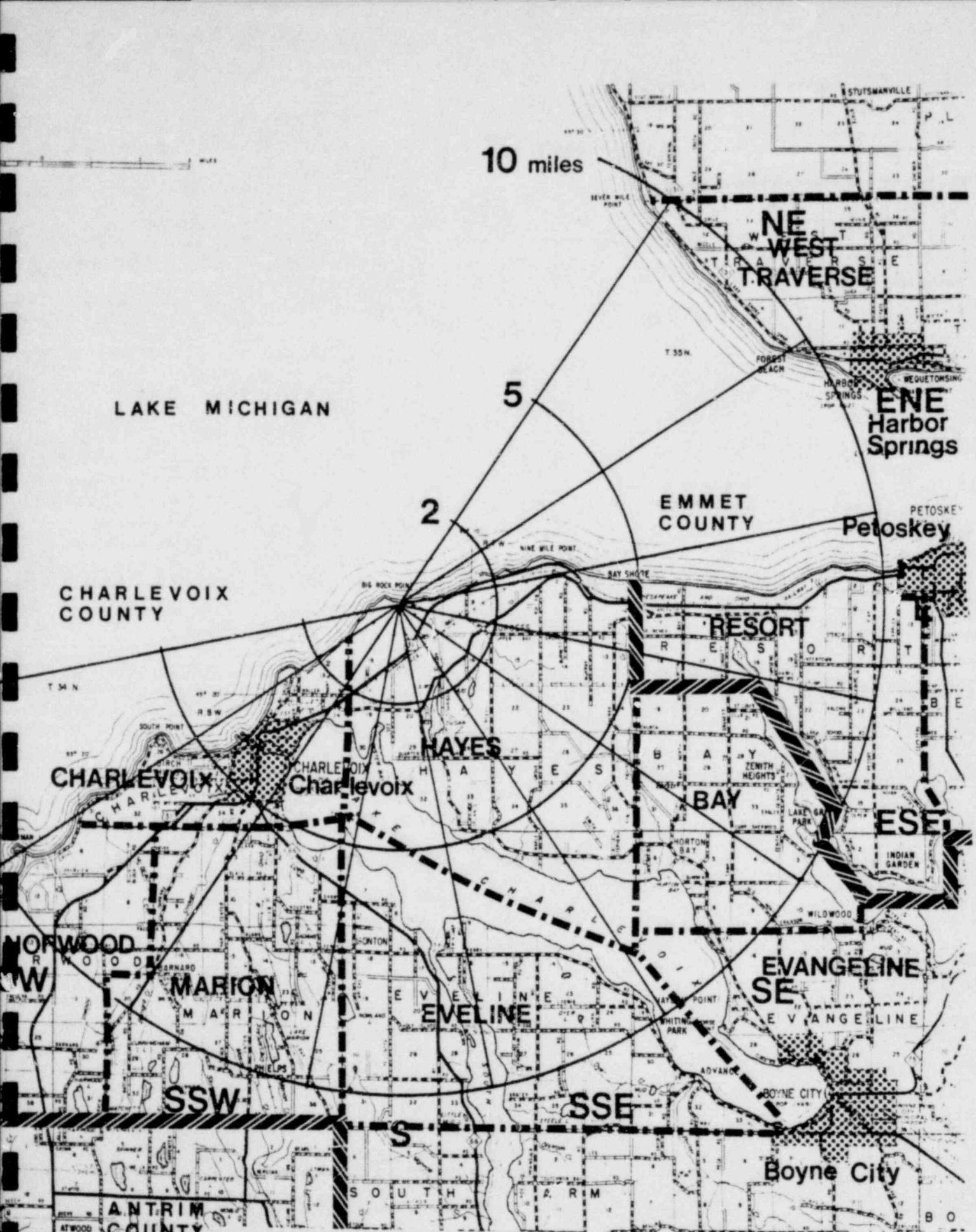

FIGURE 1

LOCATION OF COUNTY AND TOWNSHIP BOUNDARIES
WITHIN 10 MILES OF THE BIG ROCK NUCLEAR PLANT

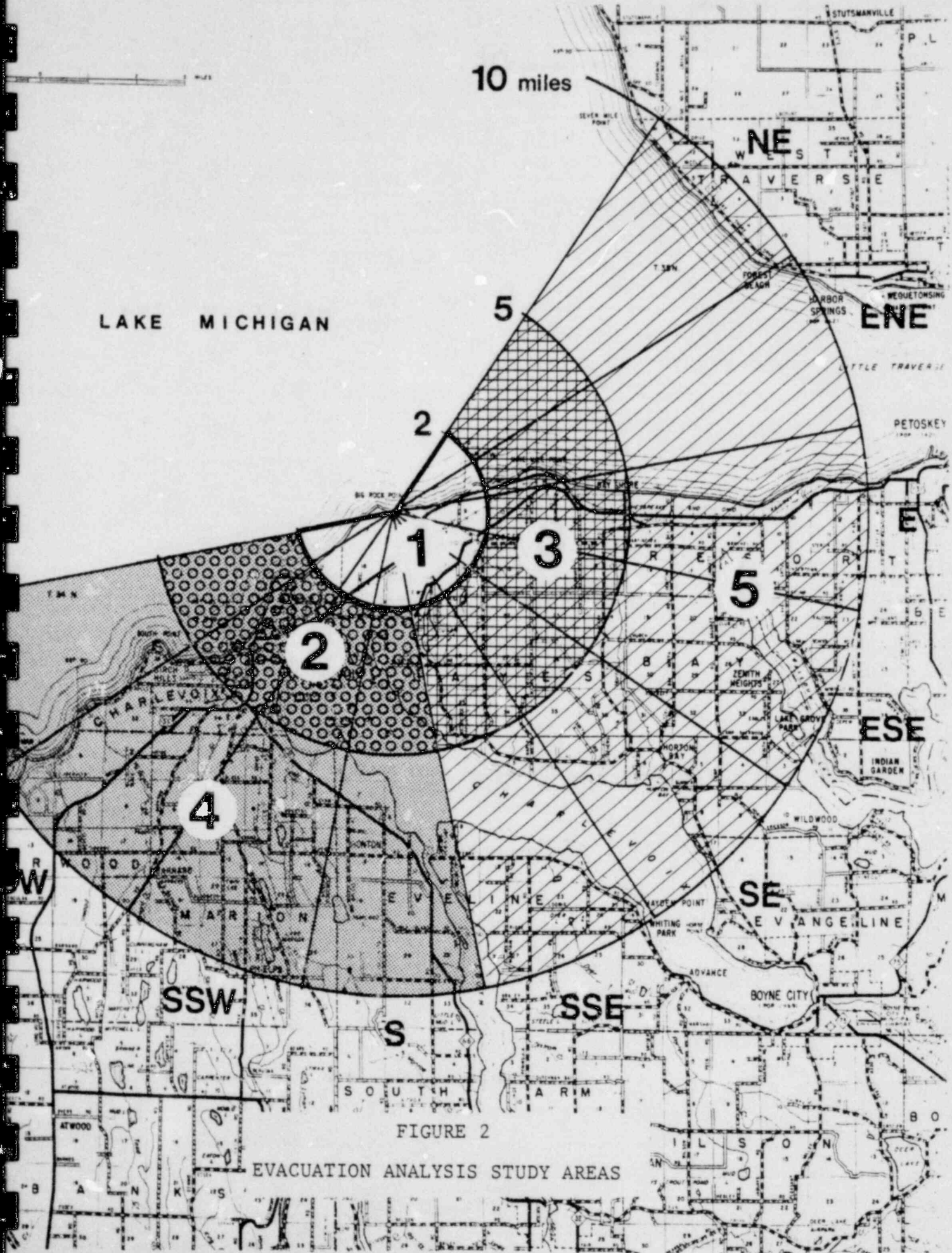

FIGURE 2

EVACUATION ANALYSIS STUDY AREAS

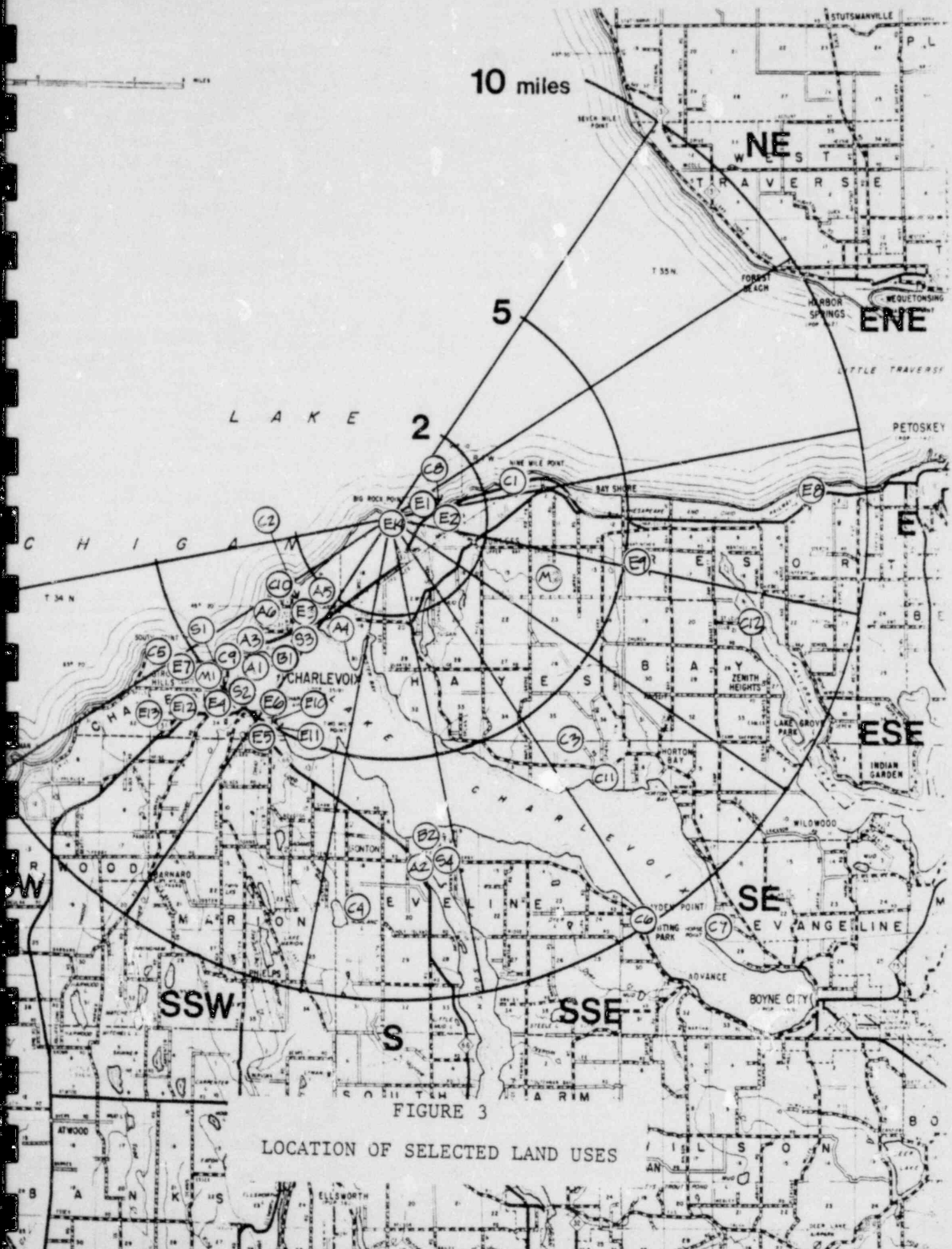

FIGURE 3

LOCATION OF SELECTED LAND USES

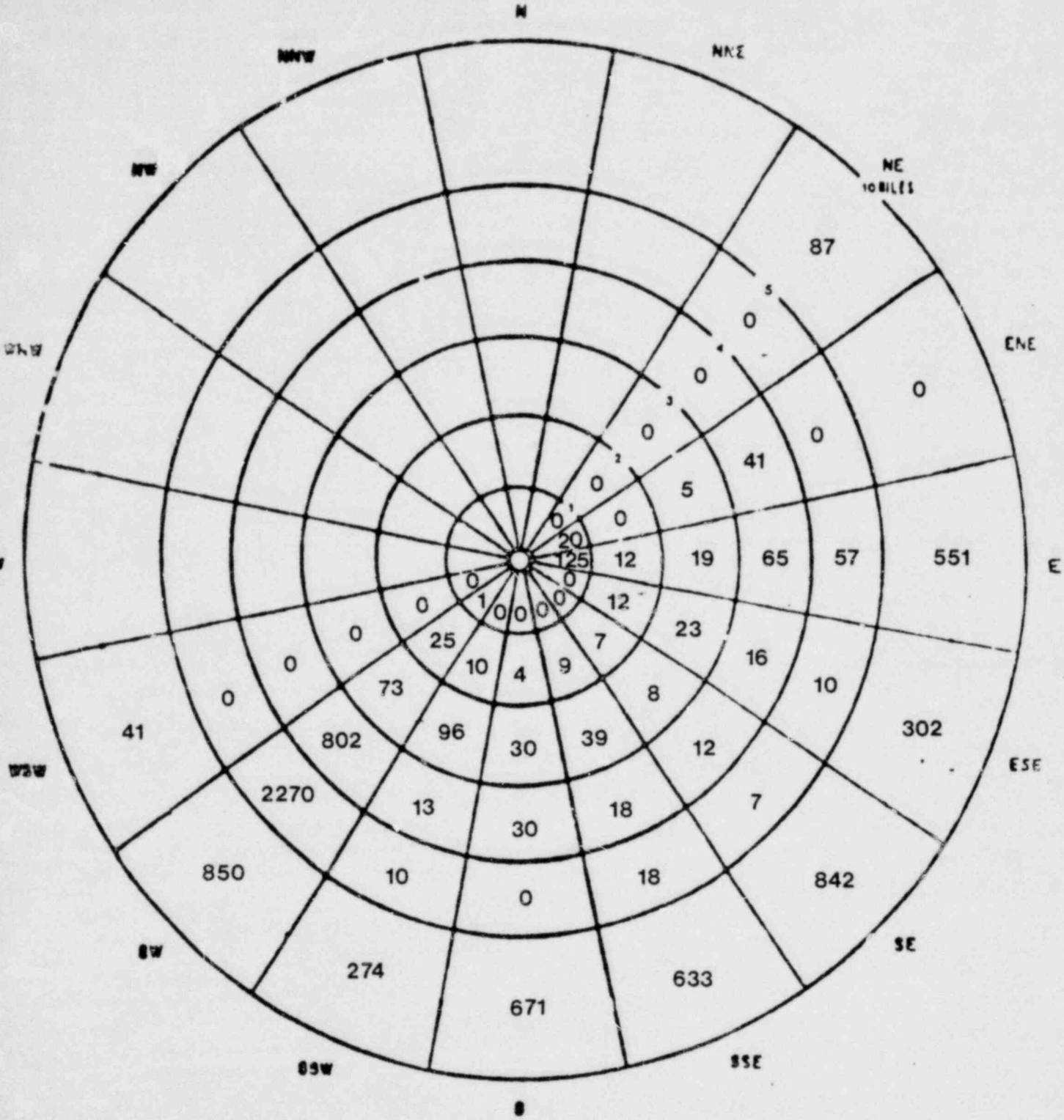

FIGURE 4

ESTIMATED NUMBER OF VEHICLES (BY COMPASS SECTOR) ASSOCIATED WITH A SUMMER WEEKEND

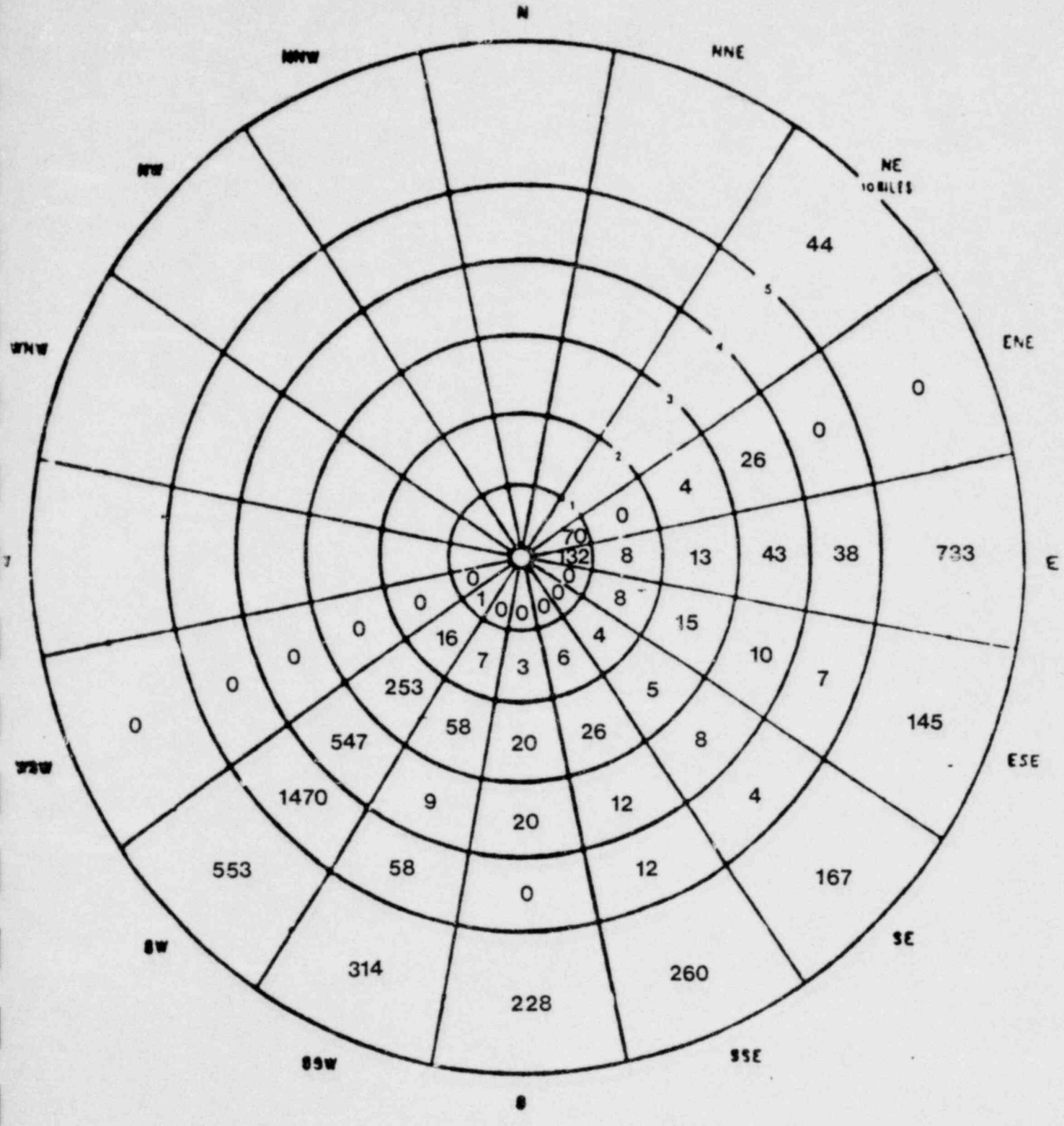

FIGURE 5

ESTIMATED NUMBER OF VEHICLES (BY COMPASS SECTOR) ASSOCIATED WITH A WINTER WEEKDAY

DOCUMENT/ PAGE PULLED

ANO. 8008010301

NO. OF PAGES 1 oversized Map

REASON:

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☐ BETTER COPY REQUESTED ON ___/___/___

☑ PAGE TOO LARGE TO FILM:

☐ HARD COPY FILED AT: PDR (CF)

OTHER _____

☑ FILMED ON APERTURE CARD NO. 8008010301

APPENDICES

APPENDIX A

NRC AND MICHIGAN DEPARTMENT OF TRANSPORTATION LETTERS

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

November 29, 1979

ALL POWER REACTOR LICENSEES

Gentlemen:

This letter, which is being sent to all licensees authorized to operate a nuclear power reactor and to all applicants for a license to operate a power reactor (FSAR docketed), is a request for information regarding estimates for evacuation of various areas around nuclear power reactors. The requested information is in addition to that requested by the October 10, 1979 letter to all power reactor licensees from Darrell G. Eisenhut, Acting Director, Division of Operating Reactors, Office of Nuclear Reactor Regulation.

Although evacuation time estimates are expected to be prepared in the course of the upgrading of the state of emergency preparedness as specified in the October 10, 1979 letter, submission of these estimates to the NRC is being requested on an accelerated time scale so that the NRC can identify those instances in which unusual evacuation constraints exist and special planning measures should be considered. In some cases of extreme difficulty where a large population is at risk, special facility modifications may also be appropriate. The requested information will also enable the NRC to be responsive to a recommendation from the Environment, Energy and Natural Resources Subcommittee of the House Committee on Government Operations. The information requested in the enclosure should be submitted no later than January 31, 1980.

The October 10, 1979 letter indicated that efforts to develop a model plan were continuing. It now appears that the model plan will not be completed on a schedule which will be of use in developing upgraded plans for the requested January 1, 1980 submittal. The upgraded plan development should therefore proceed on a site-specific basis.

Sincerely,

Brian K. Grimes, Director
Emergency Preparedness Task Group
Office of Nuclear Reactor Regulation

Enclosure:
Request for Evacuation Time
Estimates

cc w/enclosure:
Service List

REQUEST FOR

EVACUATION TIME ESTIMATES (AFTER NOTIFICATION)

FOR AREAS NEAR NUCLEAR POWER PLANTS

Background

Prior to recent NRC requests that means for prompt notification to the public be installed around each nuclear power plant site, a significant component of evacuation time estimates was the time required to notify the public of a need for evacuation. Studies of actual evacuations that have taken place generally do not distinguish between the time required for notification, the time required to implement the evacuation, and the time required to confirm that an evacuation has taken place.[1/] The estimates for time required for evacuations now requested relate primarily to the time to implement an evacuation as opposed to the time required for notification. These estimates may be based on previous local experiences (e.g., chemical spills or floods) or may be based on studies related to population density, local geography and road capacities. No standard method for making such estimates is identified for use at this time. The basis for the method chosen should be described in the response. As an independent check on the evacuation time estimates, agreement with or comments on the time estimates made should be obtained from the principal local officials responsible for carrying out such evacuations. Such agreement should be documented or the areas of disagreement indicated in the submittal.

The format given below is appropriate for reporting to the NRC estimates of the time required to implement evacuation of areas near nuclear power plants. These estimates, are to be made for the primary purpose of making available, to those officials who would make evacuation decisions in an emergency situation, knowledge of the time required to complete one of the protective action options (evacuation) available for a particular potentially affected segment of the population. A second purpose of these estimates is to identify to all concerned those instances in which unusual evacuation constraints exist and that special planning measures should be considered. In some cases of extreme difficulty where a large population is at risk, special facility modifications may also be considered.

Given a decision to evacuate rather than shelter in an actual event, fewer or more sectors or different distances than given in the reporting format might be evacuated should this be the chosen protective action. For example, three 22-1/2° sectors might be initially evacuated in a downwind direction (the sector containing the plume and an adjacent sector on each side), followed by the evacuation of other sectors as a precautionary measure.

1/ Hans, J. M., Jr., and T. C. Sell, 1974 Evacuation Risks - An Evaluation, U. S. Environmental Protection Agency, National Environmental Research Center, Las Vegas, EPA-520/6-74-002.

Format for Reporting Information

The areas for which evacuation estimates are required must encompass the entire area within a circle of about 10 miles radius, and have outer boundaries corresponding to the plume exposure EPZ. These areas are as follows:

Distance	Area
2 miles	two 180° sectors
5 miles	four 90° sectors
about 10 miles	four 90° sectors

Estimates for the outer sectors should assume that the inner adjacent sectors are being evacuated simultaneously. To the exent practical, the sector boundaries should not divide densely populated areas. Where a direction corresponding to the edges of areas for which estimates have been made is thought not to be adequately represented by the time estimates for adjacent areas, an additional area should be defined and a separate estimate made for this case. The format for submittal should include both a table and a figure (overlaid on a map) which each give the information requested in items 1 and 2 below. Additional material may be provided in associated text.

Required Information

1. Two estimates are requested in each of the areas defined in item 1 for a general evacuation of the population (not including special facilities). A best estimate is required and an adverse weather estimate is required for movement of the population.

2. The total time required to evacuate special facilities (e.g., hospitals) within each area must be specified (best estimate and adverse weather).

3. The time required for confirmation of evacuation should be indicated. Confirmation times may consider special instructions to the public (e.g., tying a hankerchief to a door or gate to indicate the occupant has left the premises).

4. Where plans and prompt notification systems have not been put in place for areas out to about 10 miles, estimates of the times required to evacuate until such measures are in place for the plume exposure emergency planning zone (EPZ) should also be given. Notification times greater than 15 minutes should be included in the evacuation times and footnoted to indicate the notification time.

5. Where special evacuation problems are identified (e.g., in high population density areas), specify alternative protective actions, such as sheltering, which would reduce exposures and the effectiveness of these measures.

6. A short background document should be submitted giving the methods used to make the estimates and the assumptions made including the routes and methods of transportation used. This document should also note the agreement or areas of disagreement with principal local officials regarding these estimates.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

RECEIVED
JUN 20 1980
NUCLEAR LICENSING

June 13, 1980

Docket No. 50-155

Mr. David P. Hoffman
Nuclear Licensing Administrator
Consumers Power Company
212 West Michigan Avenue
Jackson, Michigan 49201

Dear Mr. Hoffman:

The FEMA/NRC Steering Committee has reconsidered the appropriate size of Emergency Planning Zones for relatively small water cooled power reactors (less than 250 mw thermal). The Steering Committee has adopted the enclosed position on the planning basis for these reactors, which include your plant. The NRC's proposed rule and NUREG-0654/FEMA-REP-1 will be modified to conform to this position.

Sincerely,

Dennis M. Crutchfield

Dennis M. Crutchfield, Chief
Operating Reactors Branch #5
Division of Licensing

Enclosure:
Planning Basis

cc w/enclosure:
See next page

cc w/enclosure:
Mr. Paul A. Perry, Secretary
Consumers Power Company
212 West Michigan Avenue
Jackson, Michigan 49201

Judd L. Bacon, Esquire
Consumers Power Company
212 West Michigan Avenue
Jackson, Michigan 49201

Joseph Gallo, Esquire
Isham, Lincoln & Beale
1120 Connecticut Avenue
Room 325
Washington, D. C. 20036

Peter W. Steketee, Esquire
505 Peoples Building
Grand Rapids, Michigan 49503

Sheldon, Harmon and Weiss
1725 I Street, N. W.
Suite 506
Washington, D. C. 20006

Mr. John O'Neill, II
Route 2, Box 44
Maple City, Michigan 49664

Charlevoix Public Library
107 Clinton Street
Charlevoix, Michigan

Chairman
County Board of Supervisors
Charlevoix County
Charlevoix, Michigan 49720

Office of the Governor (2)
Room 1 - Capitol Building
Lansing, Michigan 48913

Director, Technical Assessment
Division
Office of Radiation Programs
(AW-459)
U. S. Environmental Protection
Agency
Crystal Mall #2
Arlington, Virginia 20460

U. S. Environmental Protection
Agency
Federal Activities Branch
Region V Office
ATTN: EIS COORDINATOR
230 South Dearborn Street
Chicago, Illinois 60604

Herbert Grossman, Esq., Chairman
Atomic Safety and Licensing Board
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dr. Oscar H. Paris
Atomic Safety and Licensing Board
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Mr. Frederick J. Shon
Atomic Safety and Licensing Board
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Big Rock Point Nuclear Power Plant
ATTN: Mr. C. J. Hartman
Plant Superintendent
Charlevoix, Michigan 49720

Christa-Maria
Route 2, Box 108C
Charlevoix, Michigan 49720

William J. Scanlon, Esquire
2034 Pauline Boulevard
Ann Arbor, Michigan 48103

PLANNING BASIS

FOR SMALL WATER REACTORS AND FT. ST. VRAIN

The FEMA/NRC Steering Committee has concluded that small water cooled power reactors (less than 250 MWt) and the Ft. St. Vrain gas cooled reactor may use a plume exposure emergency planning zone of about 5 miles and an ingestion pathway emergency planning zone of about 30 miles. This conclusion is based on the lower potential hazard from these facilities (lower radionuclide inventory and longer times to release significant amounts of activity for many scenarios). The radionuclides considered in planning should be the same as recommended in NUREG-0396.

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, GOVERNOR

DEPARTMENT OF TRANSPORTATION

TRANSPORTATION BUILDING, 425 WEST OTTAWA PHONE 517-373-2090
POST OFFICE BOX 30050, LANSING, MICHIGAN 48909

JOHN P. WOODFORD, DIRECTOR

February 22, 1980

Mr. Milton J. Jury
Consumers Power Company
1945 W. Parnall Road
Jackson, Michigan 49201

Dear Mr. Jury:

We directed to your attention a copy of our letter of February 11, 1980, to Mr. Holzheimer of HMM Associates, Incorporated, relating the results of the Traffic and Safety Division's further review of the Evacuation Time Estimate reports for the Big Rock and Palisades Nuclear Power Stations.

Subsequently, Mr. Donald E. Jones of HMM Associates discussed with our Mr. Conradson his suggested modifications in the Big Rock report and has made appropriate changes in that report. In addition, minor revisions have been made in the Palisades report. These several changes are summarized in Mr. Jones' letter to me dated February 19, 1980 (Reference: 80-053), a copy of which was directed to your office.

This is to advise you that the amended Evacuation Time Estimate reports for the Big Rock and Palisades Nuclear Power Stations meet with our approval.

Very truly yours,

Robert A. Rigotti
Field Administration Engineer
Traffic and Safety Division

MICHIGAN
THE GREAT LAKE STATE

An Equal Opportunity Employer

OFFICE MEMORANDUM

Cadillac, Michigan

DATE: February 6, 1980

TO: R. A. Rigotti,
Field Administration Engineer

FROM: B. A. Conradson, District
Traffic and Safety Engineer

SUBJECT: Big Rock Nuclear Power Station
Evacuation Time Estimates

My comments regarding the subject matter are as follows:

The report takes notice of probably the only two potential bottlenecks in the major (US-31) evacuation route for southbound traffic. These would be the drawbridge and a traffic signal, both of which are in downtown Charlevoix. Perhaps too much importance is assigned to the signal, the effect of which can be eliminated by point control. This is reflected in the relatively high clear time (83 min) for S.B. US-31 noted in Table 10, and the low capacity (760 v/h) for link #1 noted in Table 8. By contrast, the effects of the drawbridge are dismissed, perhaps too easily on page 12, by noting that the bridge will be directed to remain in the down position per notification via the "EOC Activation Alert List."

One other minor comment would pertain to the 2nd paragraph on page 16. The termonology is rather inaccurate and conflicting, and this information could be presented more clearly.

B. A. Conradson, District
Traffic and Safety Engineer

BAC/mr

cc: C. P. Seufert

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, GOVERNOR

DEPARTMENT OF TRANSPORTATION

TRANSPORTATION BUILDING, 425 WEST OTTAWA PHONE 517-373-2090

POST OFFICE BOX 30050, LANSING, MICHIGAN 48909

JOHN P. WOODFORD, DIRECTOR

February 11, 1980

Mr. Robert J. Holzheimer
HMM Associates, Incorporated
One Forbes Road
Lexington, Massachusetts 02173

Dear Mr. Holzheimer:

Appropriate district traffic and safety engineers from our field offices have reviewed your preliminary Evacuation Time Estimate reports for the Big Rock and Palisades Nuclear Power Stations.

Mr. Edwin H. Miller, who reviewed the Palisades report, offered no suggested changes, so we will approve that report. Mr. Bruce A. Conradson, who reviewed the Big Rock report, offered suggestions contained in the attached copy of his memorandum dated February 6, 1980. In the event you may wish to communicate directly with him, his office address is 100 East Chapin Street, Cadillac, Michigan 49601. His office telephone number is 616/775-3487.

We will hold in abeyance our official response on both reports pending your review of, and response to, Mr. Conradson's report.

Very truly yours,

Robert A. Rigotti
Field Administration Engineer
Traffic and Safety Division

Attachments

MICHIGAN
THE GREAT LAKE STATE

HMM Associates, Inc
One Forbes Road
Lexington, Massachusetts 02173 (617) 861-6670

February 19, 1980
Reference: 80-053

Mr. Robert A. Rigotti
Department of Transportation
Field Administration Engineer
Traffic and Safety Division
Transportation Building
425 West Ottawa
P. O. Box 30050
Lansing, MI 48909

Subject: Big Rock and Palisades Evacuation Time Estimates

Dear Mr. Rigotti:

As requested, enclosed are copies of the Evacuation Time Estimate reports for the Big Rock and Palisades Nuclear Power Stations. The time and effort expended by your office in reviewing these two reports is greatly appreciated.

Some changes have been made in the Big Rock report to reflect comments made by Bruce Conradson of the Cadillac office. Agreement to these changes was reached over the telephone. In addition, a few minor changes have been made to the Palisades report. Attached is a description of the changes made in each report.

As we discussed on the telephone, if your office agrees with the changes that have been made, an official response should be directed to Milt Jury. If you have any questions or comments concerning the changes, or the reports in general, please do not hesitate to contact me or Robert Holzheimer. Again, thank you very much for reviewing and commenting on these evacuation analyses.

Very truly yours,

Donald E. Jones

DEJ:alt
attachment
cc: Milt Jury

REPORT CHANGES

I. Palisades Nuclear Power Station

A. Page 8 - Footnote - A sentence was added which states that migrants are considered to be part of the general evacuation (i.e., as any other employee).

B. Pages 12-13 - Notification time steps. These were modified to reflect the wording in the County Plan, which was not available at the time of the first draft of the report.

C. Page 16 - Fourth paragraph. There are approximately 200 vehicles associated with plant (instead of 75). Therefore, based on a 3-second headway, it will take 10 minutes (instead of 4) to clear the plant access road.

D. Page 23 - Both winter and summer estimates are approximately the same. The change is due to the increased capacity at the signal in Bangor (changed from 385 v/h to 575 v/h).

E. Table 2 - There are approximately 200 (not 75) employees at the Palisades plant.

F. Table 7 - Link #57 capacity changed to 575 v/h from 385 v/h due to reevaluation of green time at signal in Bangor.

G. Table 8 - The clear time estimates for the 0-10 mile radius along 30th Avenue east have been lowered to 135 minutes in summer (was 194) and 165 minutes in winter (was 242). This is due to the capacity change at the signalized intersection in Bangor.

H. Appendix E - Figure E-5. Clear times changed to reflect change in capacity at signalized intersection in Bangor.

I. Appendix F - The EOC Activation Alert List has been included.

II. Big Rock Nuclear Power Station

A. Page 16 - 2nd paragraph. Reworded paragraph to reflect suggested changes by Bruce Conradson. Distinguished between the blinking beacon and the operational signals.

B. Pages 18-19 - Added paragraphs further detailing the operation of the drawbridge and the signal in downtown Charlevoix. New clear time estimates (5-25 minuntes less) were derived assuming point control at the signalized intersection. There is a description of normal drawbridge operation and a special note made that the operator will be instructed to keep the bridge in a down position during an evacuation. The operator is a MDOT employee.

C. Table 10 - Added clear time estimates assuming point control at the signalized intersection in downtown Charlevoix.

NRC LETTER

APPENDIX B

DISTRIBUTION OF VEHICLE DEMAND ESTIMATES FOR PERMANENT, SEASONAL & TRANSIENT POPULATIONS

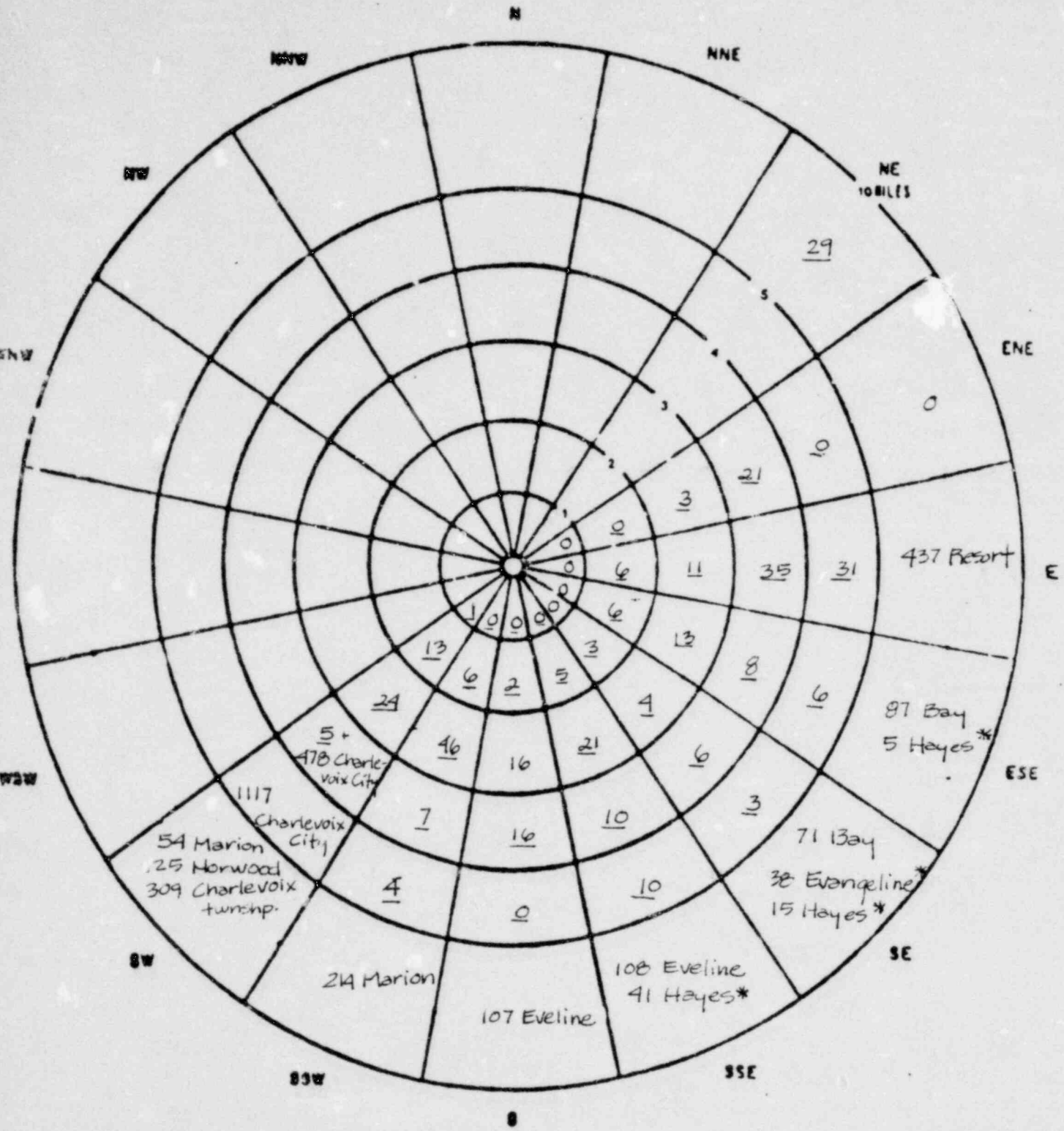


FIGURE B-1

ESTIMATED NUMBER OF VEHICLES ASSOCIATED WITH YEAR-ROUND POPULATION
(assuming 1 vehicle per residence), (SUMMER and WINTER)

- underlined numbers indicate number of residences as counted from Consumers Power Report, 0-4 miles.
- * indicates number of residences as counted from Bayshore, Mich. U.S.G.S. map, 1958.

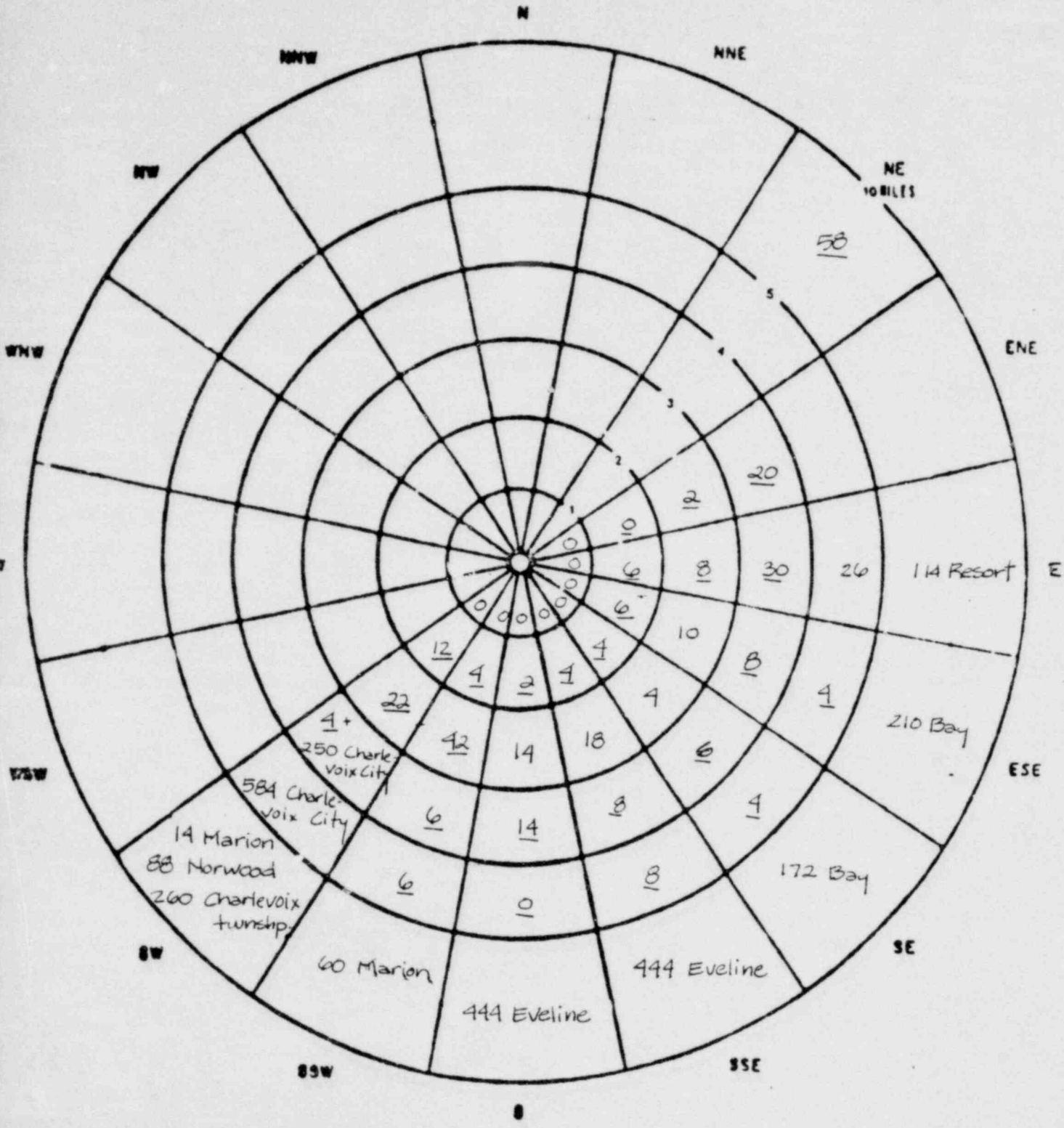


FIGURE B-2

ESTIMATED NUMBER OF VEHICLES ASSOCIATED WITH SEASONAL POPULATION - SUMMER (assuming 2 vehicles per residence)

- underlined numbers indicate number of residences as counted from Consumer Power Report, 0-4 miles (seasonal residences assumed to be 30% of total residences).

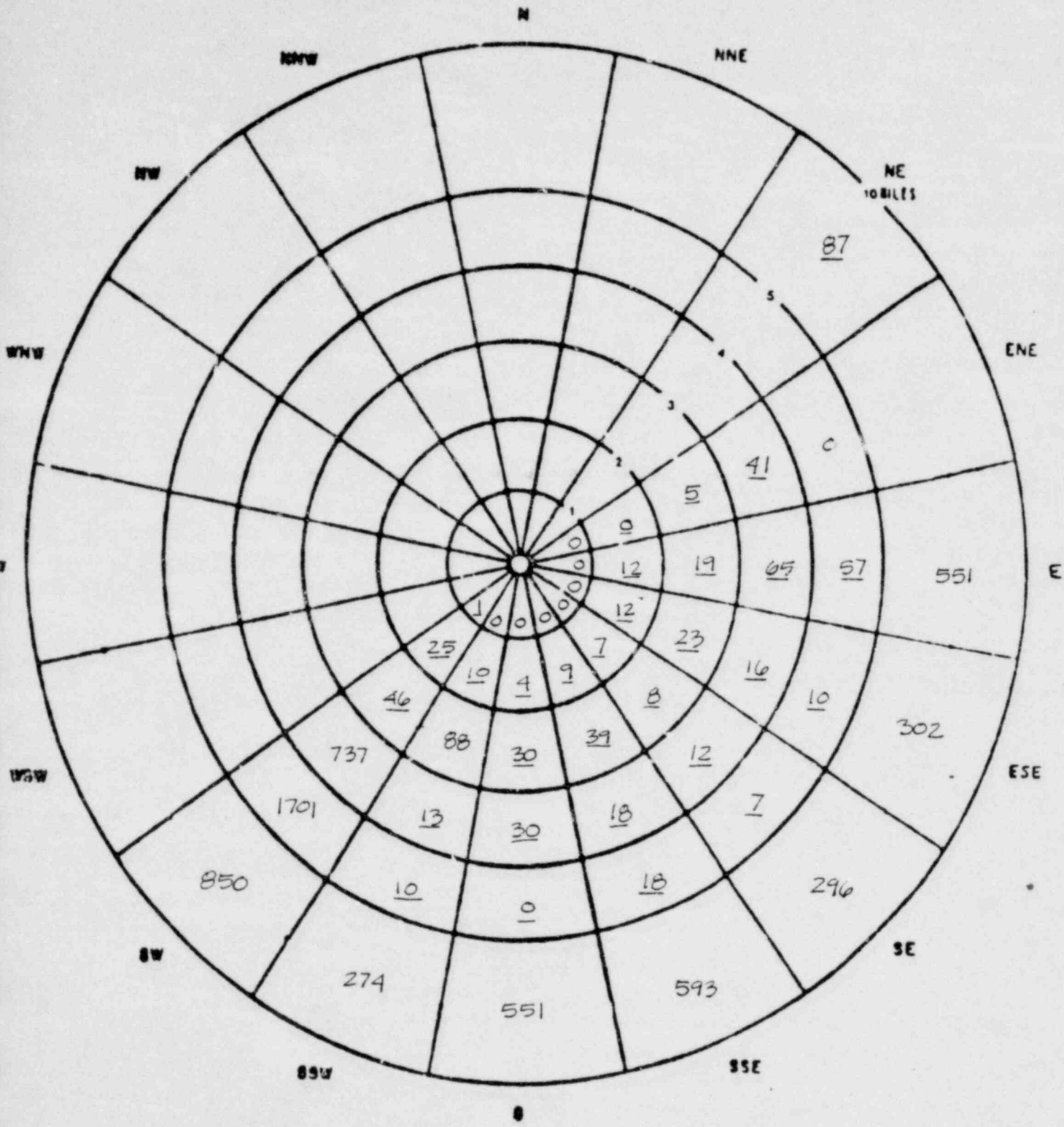


FIGURE B-3

ESTIMATED NUMBER OF VEHICLES ASSOCIATED WITH ALL RESIDENCES
(year-round and seasonal) - SUMMER

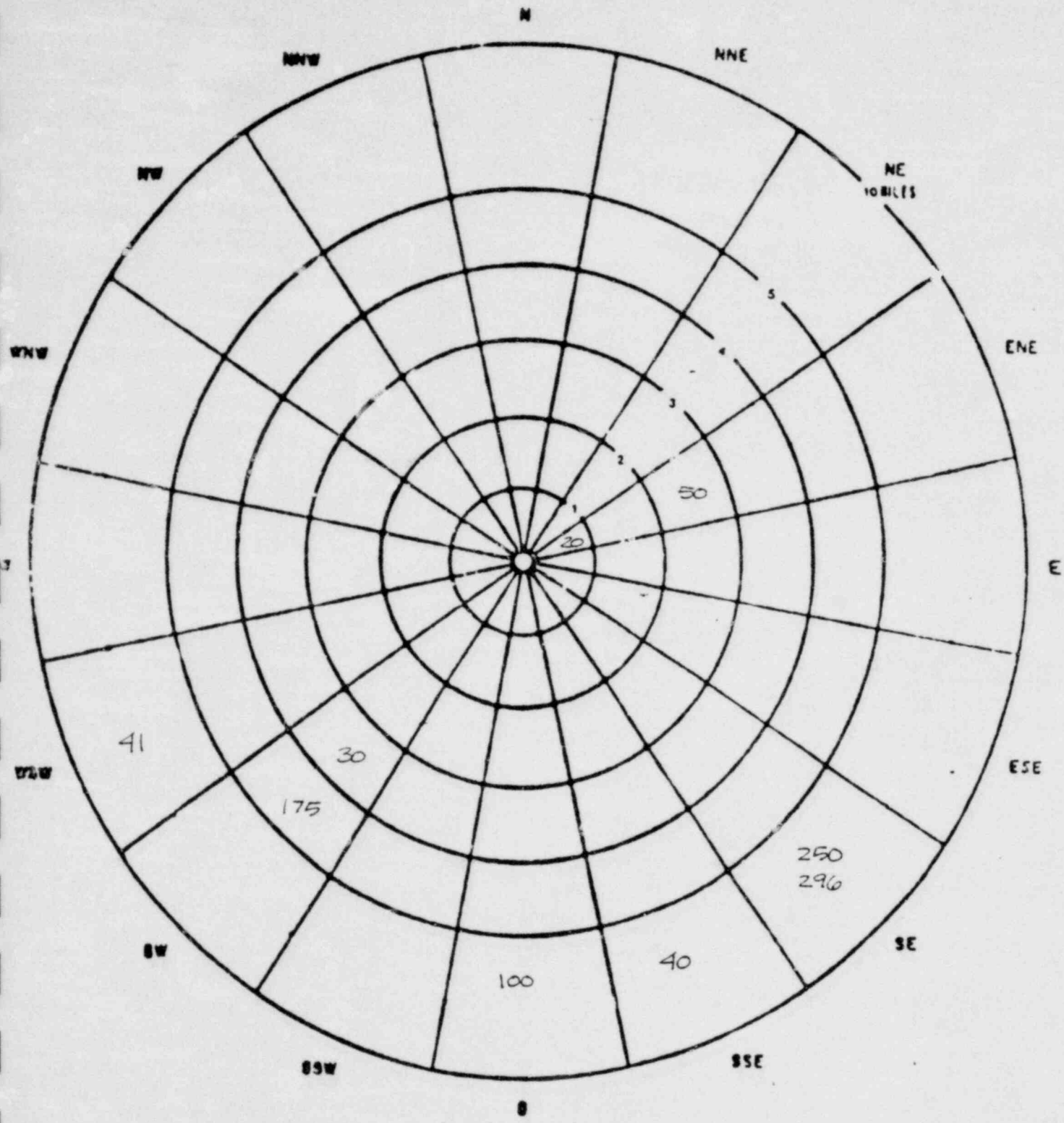


FIGURE B-4

ESTIMATED NUMBER OF VEHICLES ASSOCIATED WITH CAMPS & CAMPGROUNDS
- ASSUMED SUMMER PEAK

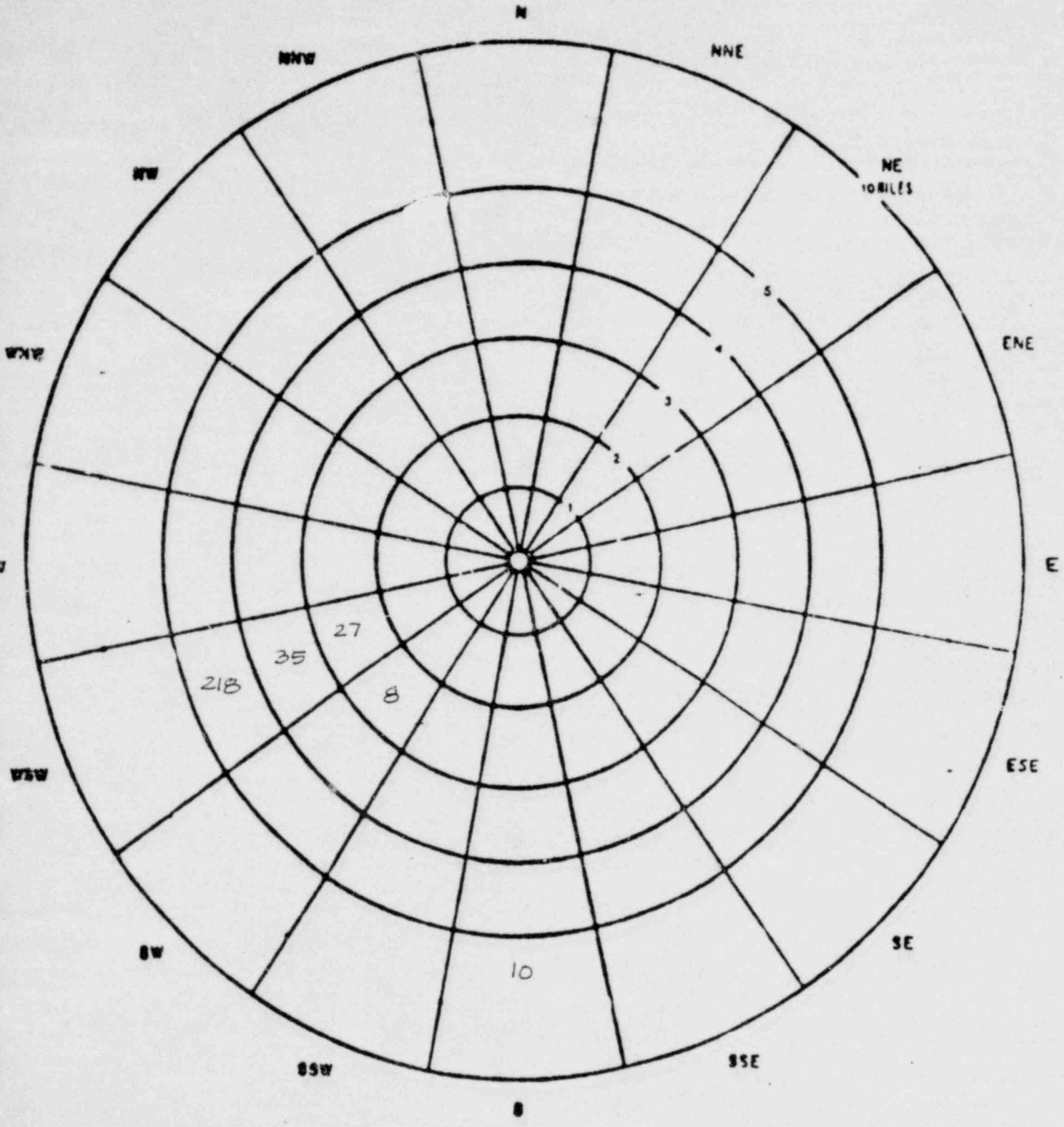


FIGURE B-5

ESTIMATED NUMBER OF VEHICLES ASSOCIATED WITH ACCOMMODATIONS
(hotels, motels, cottages) - ASSUMED SUMMER PEAK

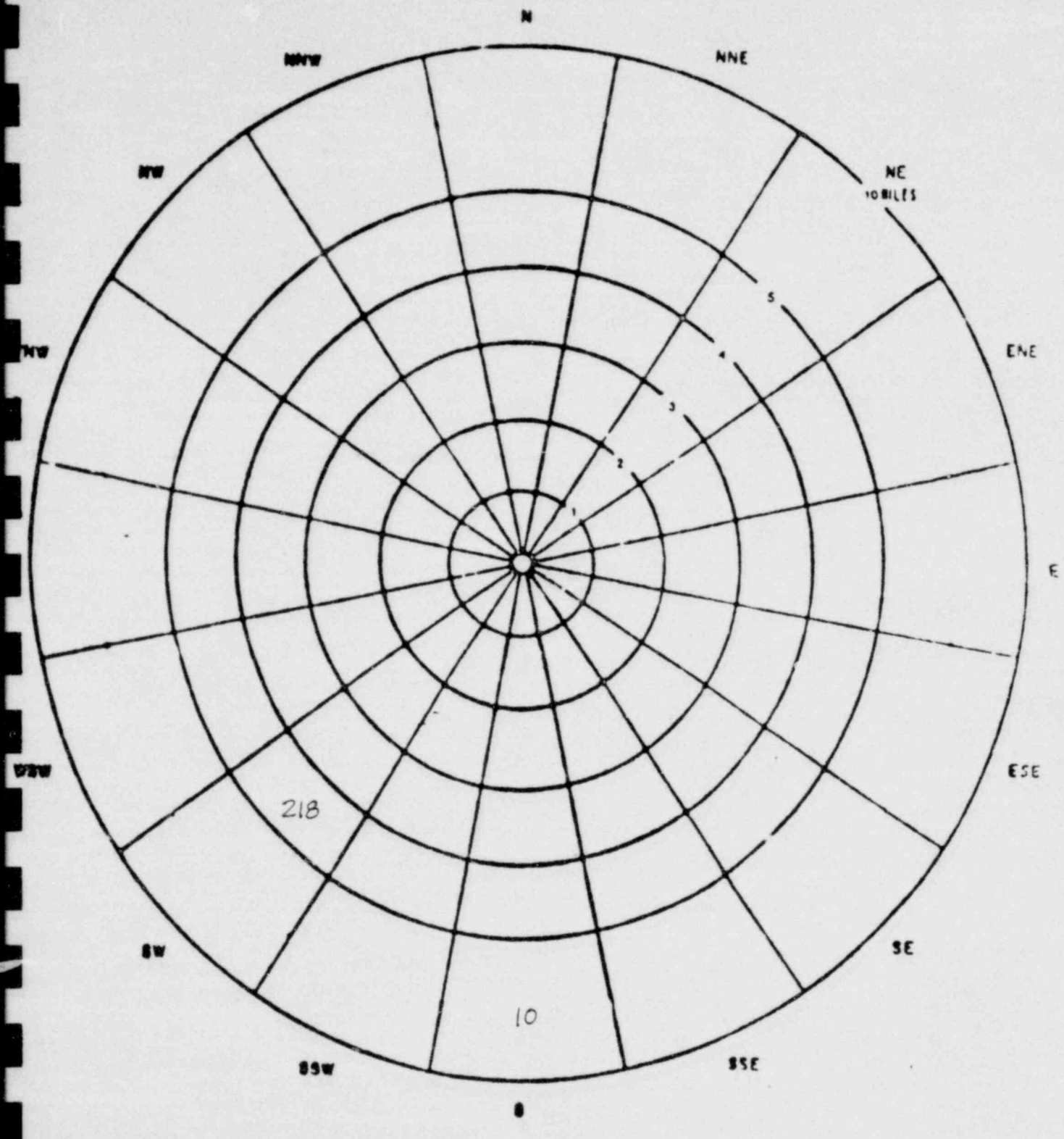


FIGURE B-6

ESTIMATED NUMBER OF VEHICLES ASSOCIATED WITH RECREATIONAL BOATING
ASSUMED SUMMER PEAK

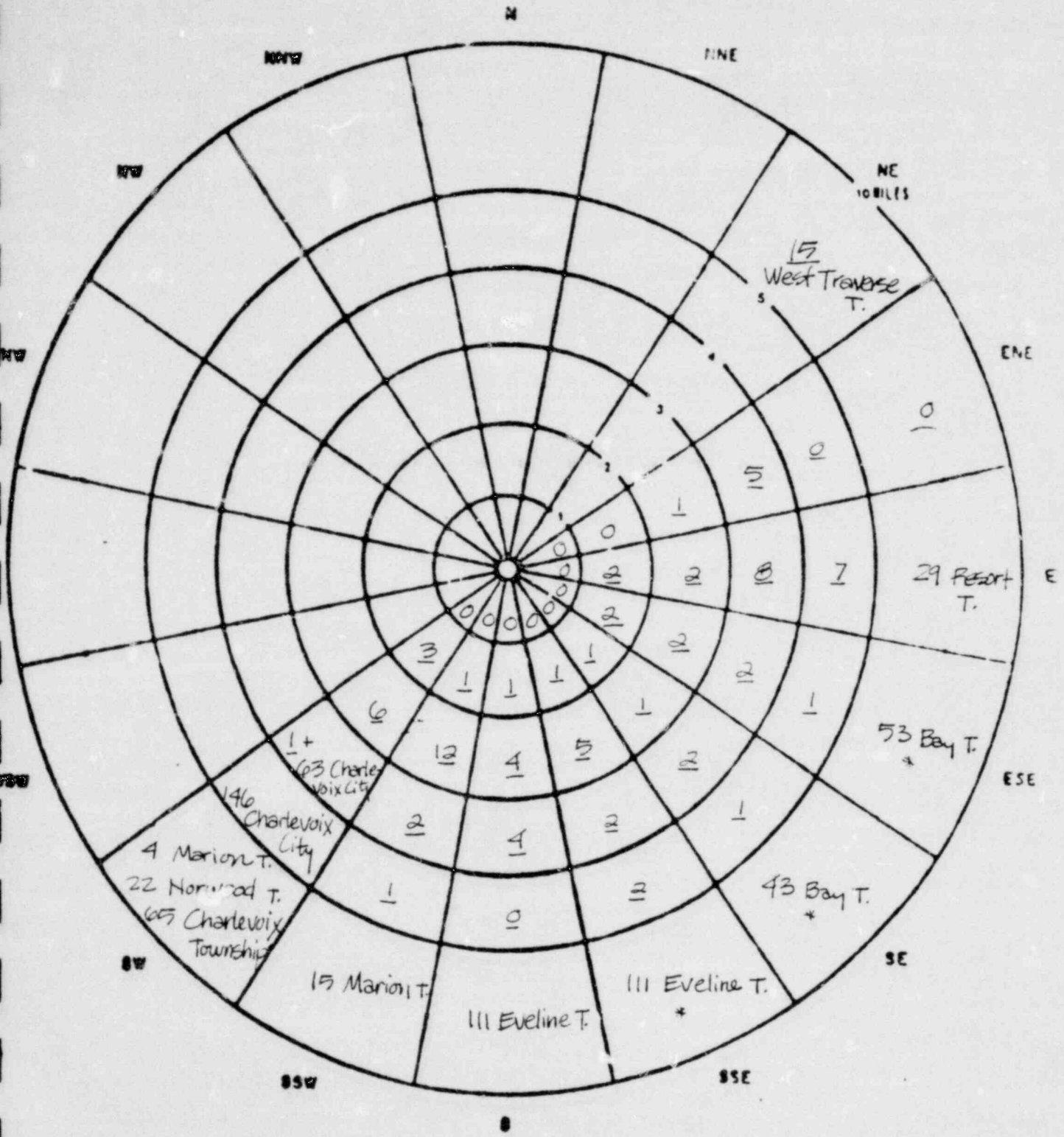


FIGURE B-7

ESTIMATED NUMBER OF VEHICLES ASSOCIATED WITH 50% OF SEASONAL DWELLING UNITS - WINTER
(assuming 1 vehicle/dwelling unit)

*Dwelling units counted from the Bayshore, Mich. U.S.G.S. map in the ESE sector (Hayes), SE sector (Evangeline and Hayes) and SSE sector (Hayes) were all designated as year-round rather than seasonal units. See Figure B-1.

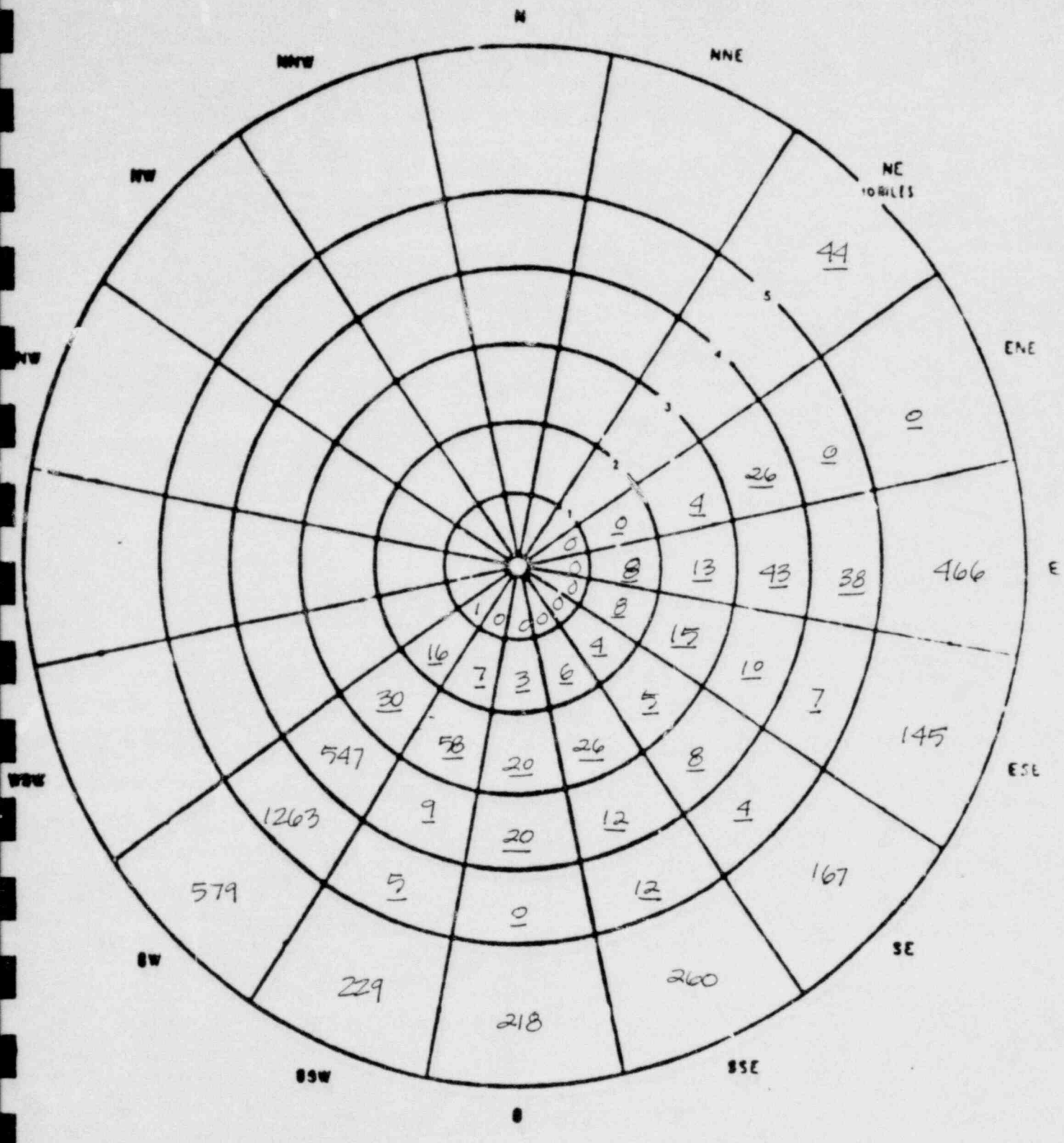


FIGURE B-8

ESTIMATED NUMBER OF VEHICLES ASSOCIATED WITH ALL DWELLING UNITS
(Year-round & Seasonal) - WINTER

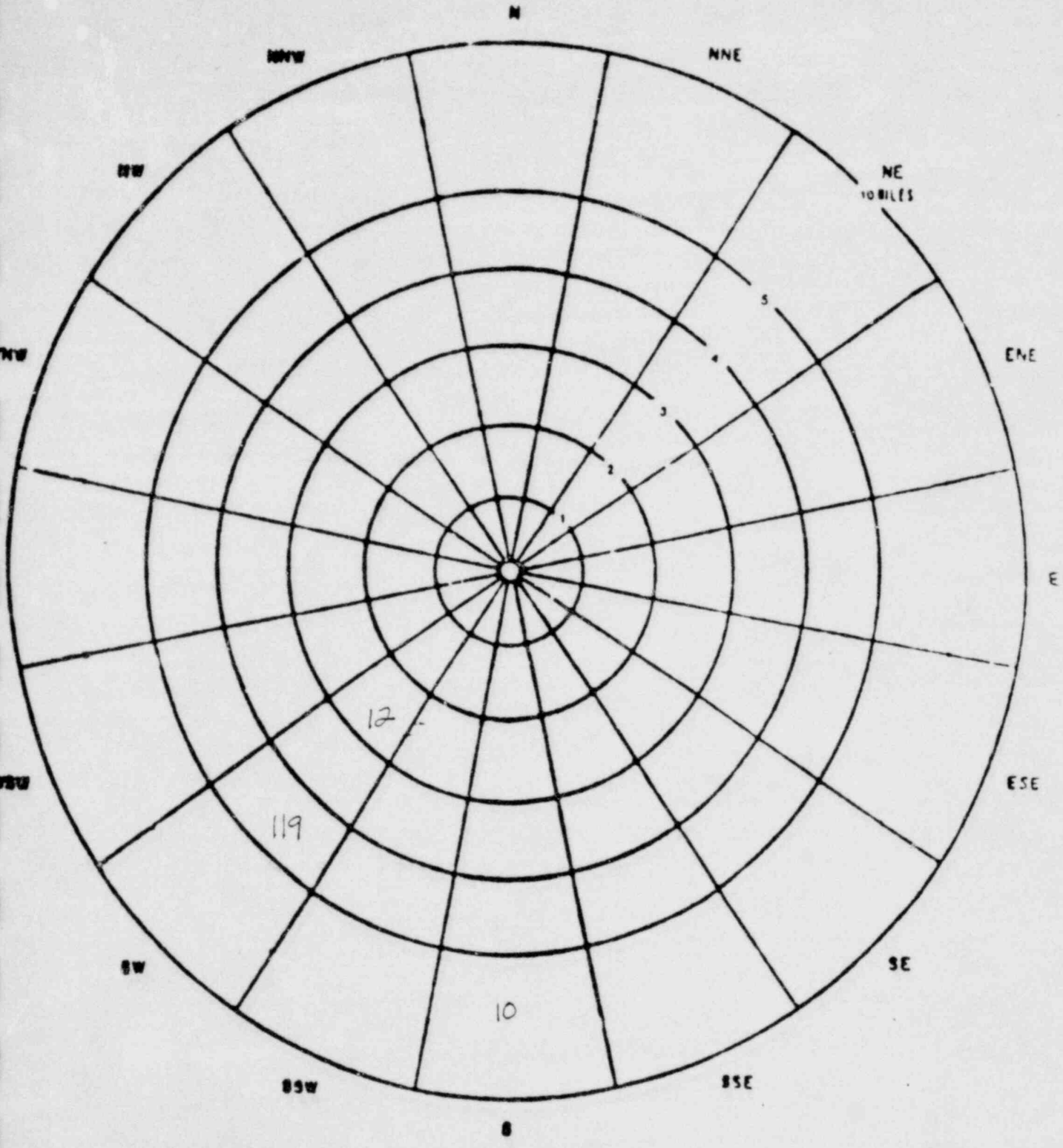


FIGURE B-9

ESTIMATED NUMBER OF VEHICLES ASSOCIATED WITH ACCOMMODATIONS
- ASSUMED WINTER PEAK

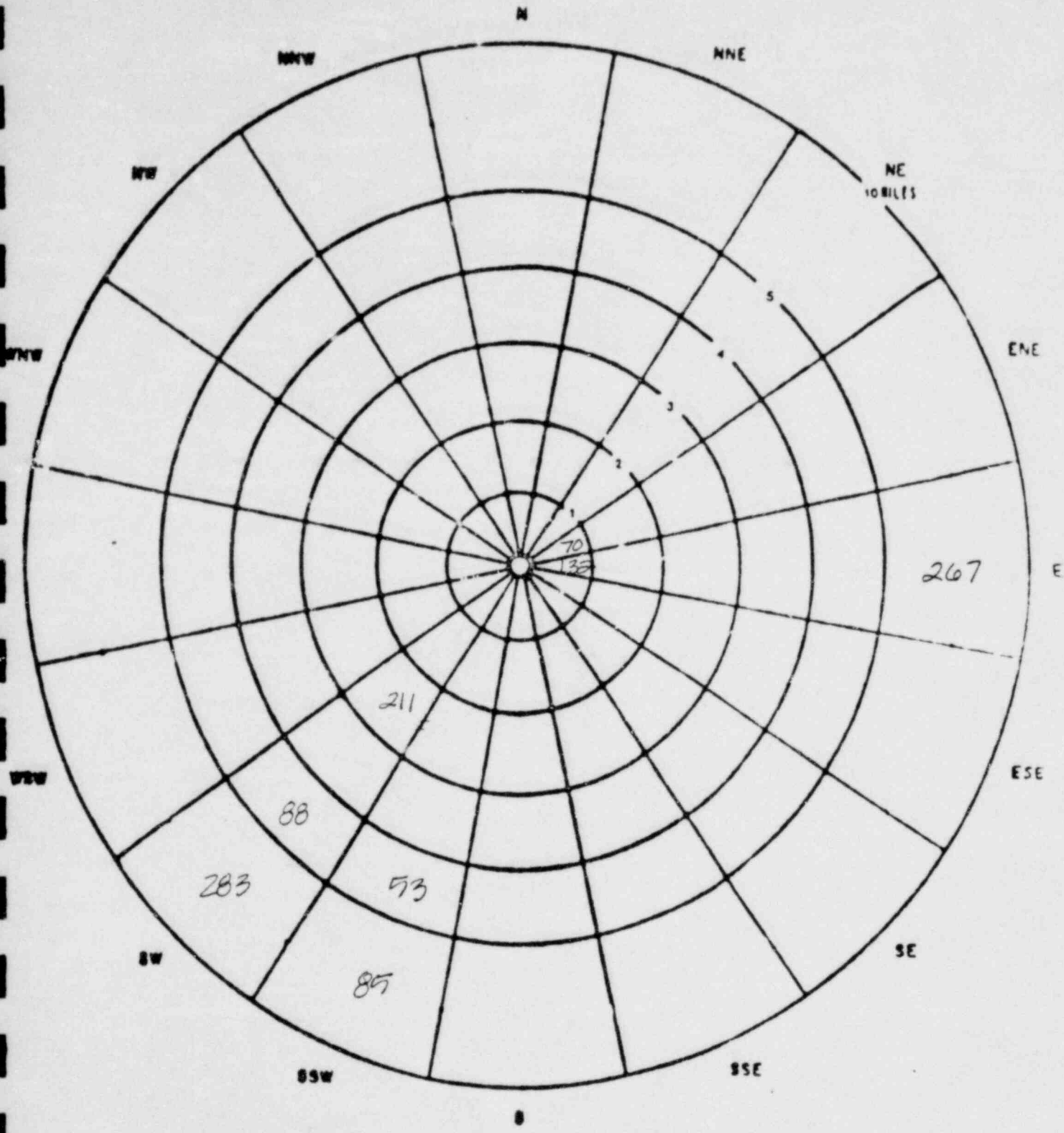
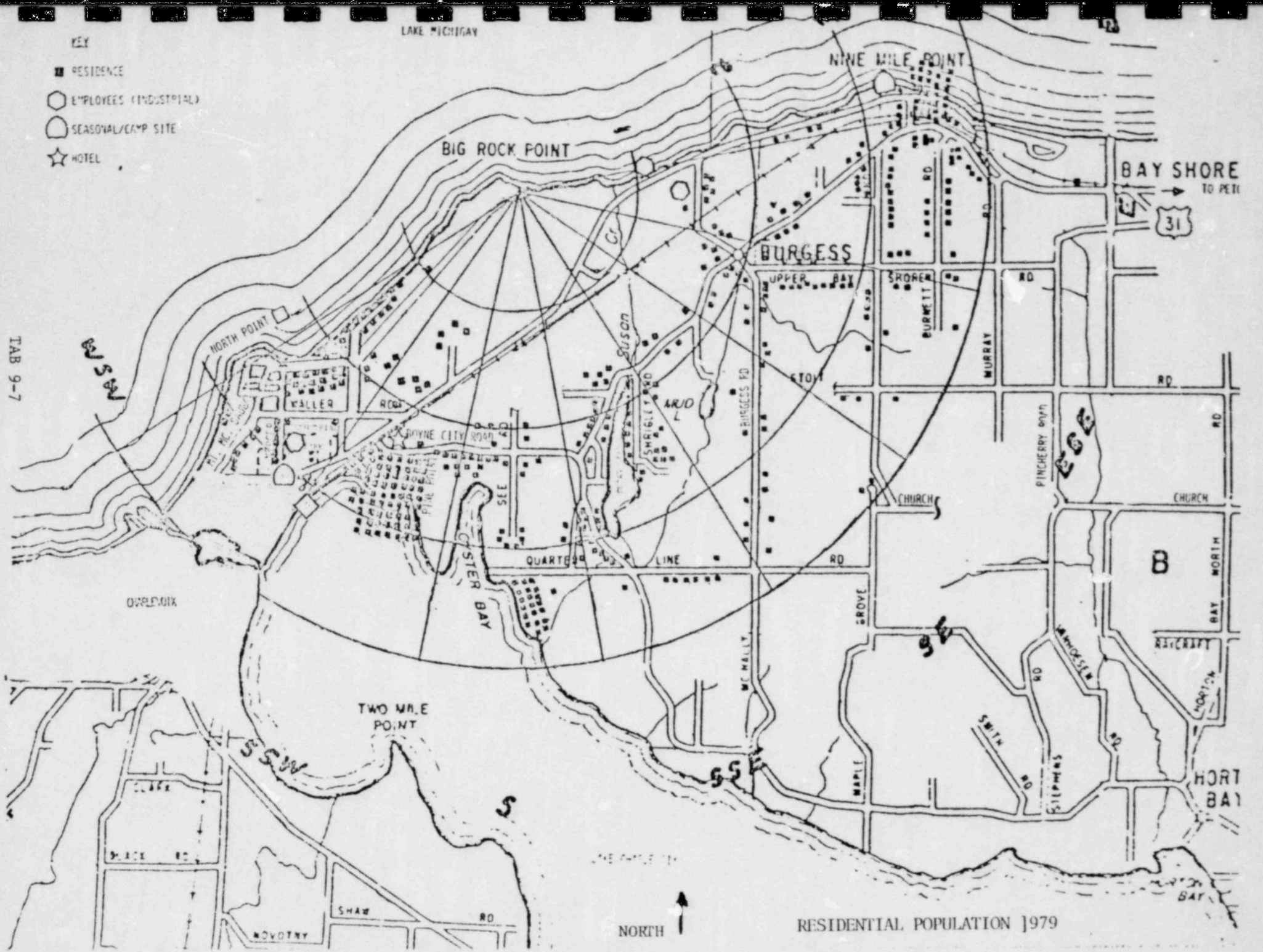


FIGURE B-10

ESTIMATED NUMBER OF VEHICLES ASSOCIATED WITH MAJOR EMPLOYERS
(assuming 1 vehicle/employee)

APPENDIX C

1979 SURVEY OF HOUSING UNITS


KEY
RESIDENCE
EMPLOYEES (INDUSTRIAL)
SEASONAL/CAMP SITE
HOTEL
LAKE MICHIGAN
NINE MILE POINT
BIG ROCK POINT
BAY SHORE
TO PET
31
BURGESS
UPPER BAY
SROKER
BURNETT
MURRAY
RD
NORTH POINT
KALLER
BOYNE CITY ROAD
BUSCH
SHERIDAN
MUD
BURGESS RD
STON
PINCHERRY ROAD
CHURCH
QUARTER LINE
SIS
OSTER BAY
B
BAY NORTH
AIRCRAFT
MC NALLY
GROVE
SMITH RD
MAPLE
HORTON
TWO MILE POINT
SHAW
NOVOTNY
NORTH
RESIDENTIAL POPULATION 1979

TAB 9-7

CALCULATIONAL METHODS TO DETERMINE RESIDENCES IN CHARLEVOIX WITHIN THE FOUR MILE CONCENTRIC RING

The town of Charlevoix is partially within the four mile concentric ring. The rings circumscribe a locus centered at the Big Rock Point Plant. The land use survey contains the part of Charlevoix designated by the City of Charlevoix designated by the City as the first ward. Two methods of obtaining the approximate first ward residences were used. The first method uses the relative areas of Charlevoix (1st ward area VS total area).

The maps representation of the town of Charlevoix and the 1st ward were traced on graph paper. The relative area was calculated by counting the number of squares within the trace.

$$\text{Weighting Factor} = WF_a = \frac{\text{Number of Squares 1st Ward}}{\text{Number of Total Squares}}$$

$$WF_a = \frac{49}{196} = .25$$

The second method of calculating involves a ratio of 1st ward voters to the total number of voters.

$$WF_v = \frac{\text{Number of 1st Ward Voters}}{\text{Total Number of Voters}}$$

$$WF_v = \frac{740}{2423} = .3054$$

When multiplied by the total population of Charlevoix, these weighting factors give the approximate 1st ward population.

Voter Weighted Population = $P_v = .3054$ (Population)

Area Weighted Population = $P_a = .25$ (Population)

$$P_v = .3054\ P$$

$$P_a = .25\ P$$

The estimated population of ~~Charlevoix~~ City is 4500 based on a 1970 census of 3519 Chamber of Commerce estimates.

$$P_v = .3054\ (4500) = 1375$$

$$P_a = .25\ (4500) = 1125$$

The reason for a larger population estimate for the voter weighted is that the population of Charlevoix is not uniformly distributed. The business, park, pier areas and a low density (population) area exist outside of the 1st ward. A sample count of the 1st ward residences was taken. The sample count showed that the P_v value is the best estimate and should yield a conservative result.

A People Per Electric Meter Ratio is known. This ratio will be referenced to as the People Per Meter Factor (PPMF).

PPMF = 2.9

When the population is divided by the PPMF, the number of residences is the result.

R_v = 137512.9 = 475

Therefore, there are approximately 475 residences in the City of Charlevoix within the four mile radius.

REFERENCES

PERSONAL COMMUNICATION WITH [redacted] - CHARLEVOIX CHAMBER OF COMMERCE

Population (1970 Census)	3519
Population (1979 Estimate)	4500
Number of 1st Ward Voters	740
Number of 2nd Ward Voters	795
Number of 3rd Ward Voters	888

Industrial Information:

1. Charlevoix Chemical Company
   Martin Road - P O Box 456
   Charlevoix, MI 49720 - Phone 616/547-9975
   5 Employees

2. Charlevoix Manufacturing Company
   400 Martin Road
   Charlevoix, MI 49720 - Phone 616/547-4451

   32 Employees

3. Lexalite Corporation
   North US 31
   Charlevoix, MI 49720 - Phone 616/547-6584

   110 Employees

4. Lietz Industries
   North US 31
   Charlevoix, MI 49720 - Phone 616/547-2891

   7 Employees

5. Weather Shield Sports Equipment, Inc.
   Petoskey Road, Rt #3, Box 227
   Charlevoix, MI 49720 - Phone 616/547-6534

   75 Employees

6. The Will-Flow Corporation
   Rt #3, Petoskey Road, Box 500
   Charlevoix, MI 49720 - Phone 616/547-6545

   60 Employees

PERSONAL CONVERSATIONS WITH OWNERS, MANAGERS, EMPLOYEES

Charlevoix Products, Inc	11 employees
Cash Register Exchange, Inc	10 employees
Weathershield Sports Equipment	75 employees
Camp Ground	30 campers
Service Center	30 cars
Lexalite	110 employees
Lexalite Maximum Present	70
Lietz Industries	7 employees

J H CLIMER - M-930A

People per meter (residence) factor (1978) - 2.9

APPENDIX D

CAPACITY CALCULATIONS

The Highway Capacity Manual was used to calculate the capacities of the evacuation roadways within the 10-mile radius of the plant. The methodology differs for 2 and 4 lane roadways and for signalized intersections. There are two sections of U.S. 31 in Charlevoix which have 4 travel lanes. Similarly, there is one signalized intersection in the 10-mile radius located in downtown Charlevoix. The remaining roadways have 2 travel lanes. Following are sample calculations for determining roadway capacity.

A. Two Lane Roadway

The Manual devotes Chapter 10 to capacity determinations for highways without access control. The formula used to calculate the capacity of a 2-lane roadway is: $C = 2000\ W_c T_c$

where: C = capacity (mixed vehicles per hour, total in both directions)

W_c = adjustment for lane width and lateral clearance at capacity (from Tables)

T_c = truck factor at capacity (from Tables).

The number 2000 represents the theoretical capacity of a 2-lane roadway. The lane width adjustment results in a decrease in the capacity for travel lanes less than 12 feet in width. The adjustment also accounts for the distance to the nearest obstruction from the traffic lane. The closer the obstruction, the lower the capacity. Where trucks are present, the capacity of 2000 vehicles/hour is reduced by a factor which reflects the percentage of trucks on the roadway and the type of terrain (level, rolling, or mountainous). Truck percentages were obtained from Michigan highway data and were only placed on major highways. Following is a sample calculation: $C = 2000\ W_c\ T_c$.

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Given: a) 2 travel lanes
b) 9 foot lanes
c) 6 feet to the nearest obstruction
d) 5% trucks
e) level terrain (0-2% slope)

Using the correct tables, the adjustments to the 2000 value are obtained. For this roadway, W_c = 0.76 and T_c = 0.95. Therefore, the capacity will be 2000 x (0.76) x (0.95) = 1444 vehicles/hour. This capacity is for a segment of U.S. 31 from Mercer Road to Waller Road in Charlevoix. This value is for both directions. However, in an evacuation, there will be little or no opposing traffic, resulting in this value being reasonable for one direction.

B. Four Lane Roadway

The capacity determination for four lane roadways is also included in Chapter 10 of the Manual. The method is essentially the same with adjustments made to reflect a lesser affect of obstructions and trucks on roadway capacity. The formula used to calculate the capacity of a four lane roadway is: $C = 2000\ N\ W\ T_c$.

Where: C = capacity (mixed vehicles per hour, total for one direction)
N = number of lanes (in one direction)
W = adjustment for lane width and lateral clearance (from Tables)
T_c = truck factor at capacity (from Tables).

Following is a sample calculation used to calculate the capacity of U.S. 31 from the drawbridge to Mercer Road in Charlevoix. The link has four 9-foot lanes with 5% trucks and a 4% grade. The nearest obstruction is at the pavement edge. Using the correct tables, the adjustments can be made. For this segment, N = 2, W = 0.7 and T_c = 0.87 resulting in a calculated capacity of 2440 vehicles/hour for both lanes.

C. Signalized Intersection

Chapter 6 of the Manual describes the method for determining the capacity of a roadway at a signalized intersection. Data needed include the approach width, signal green time, the signal cycle, the number of left and right turns, location of the intersection (rural, fringe area, downtown), and the percentage of trucks.

Also included in the analysis is the Peak Hour Factor (PHF). At intersections, the vehicle demand may not exceed the capacity over a one-hour period. However, there are peak volumes of traffic that arrive at the intersection (in a 15-minute period, for example) which results in a short-term capacity constraint. The PHF is a ratio of the number of vehicles counted during the peak hour and four times the number of vehicles counted during the highest 15 consecutive minutes. Since the capacity of the roadway is to be determined, the PHF will be close to 1.00. The Manual suggests a value between 0.85 and 1.00. A value of 0.95 was used. The next step in the procedure is to determine the theoretical intersection approach volume (vehicle per hour of green). This is determined by using the appropriate figures in the Manual. Needed input to the figures include approach width and the load factor. The load factor represents the degree of utilization of an intersection approach roadway during one hour of peak traffic flow. A value of 0.85 is suggested in the Manual. This means that 85% of the green phases are fully utilized (i.e., vehicles always present). This appoach volume is then modified by numbers found in appropriate tables which reflect the percentage of turns at the intersection, intersection location and truck percentage.

Following is a sample calculation for the signalized intersection at U.S. 31 and Clinton Street in downtown Charlevoix. Concern is with the capacity on U.S. 31. The approach width is 15 feet with 40 seconds of green time and a signal cycle of 70

seconds. It is assumed that there will be no left or right turns from U.S. 31 onto Clinton Street. There are 5% trucks and the intersection is located in the central business district. Based on the approach width, the approach volume is 900 vehicles/hour. Adjustments to this value are:

peak hour factor	= 0.95
no left turns	= 1.2
no right turns	= 1.3
5% trucks	= 1.0
central business district	= 1.0
$\frac{\text{green time}}{\text{cycle time}}$	= 0.57

Therefore, the capacity of the roadway due to the intersection will be 900 x (0.95) x (1.2) x (1.3) x (1.0) x (1.0) x (0.57) = 760 v/h.

APPENDIX E

EVACUATION ROUTINGS

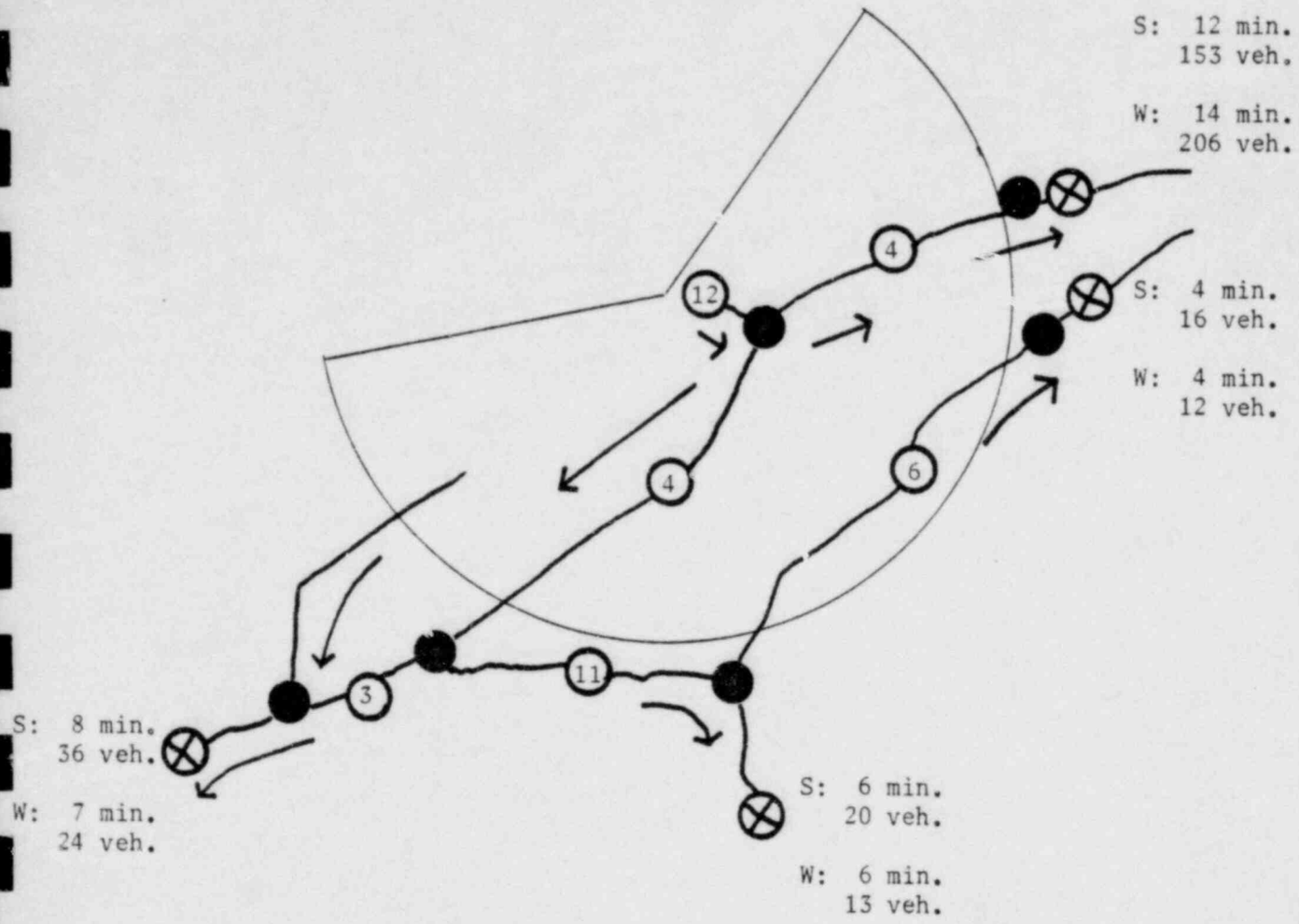

FIGURE E-1

EVACUATION ROUTINGS
ANALYSIS AREA 1 0-2 MILES

S - Summer
W - Winter

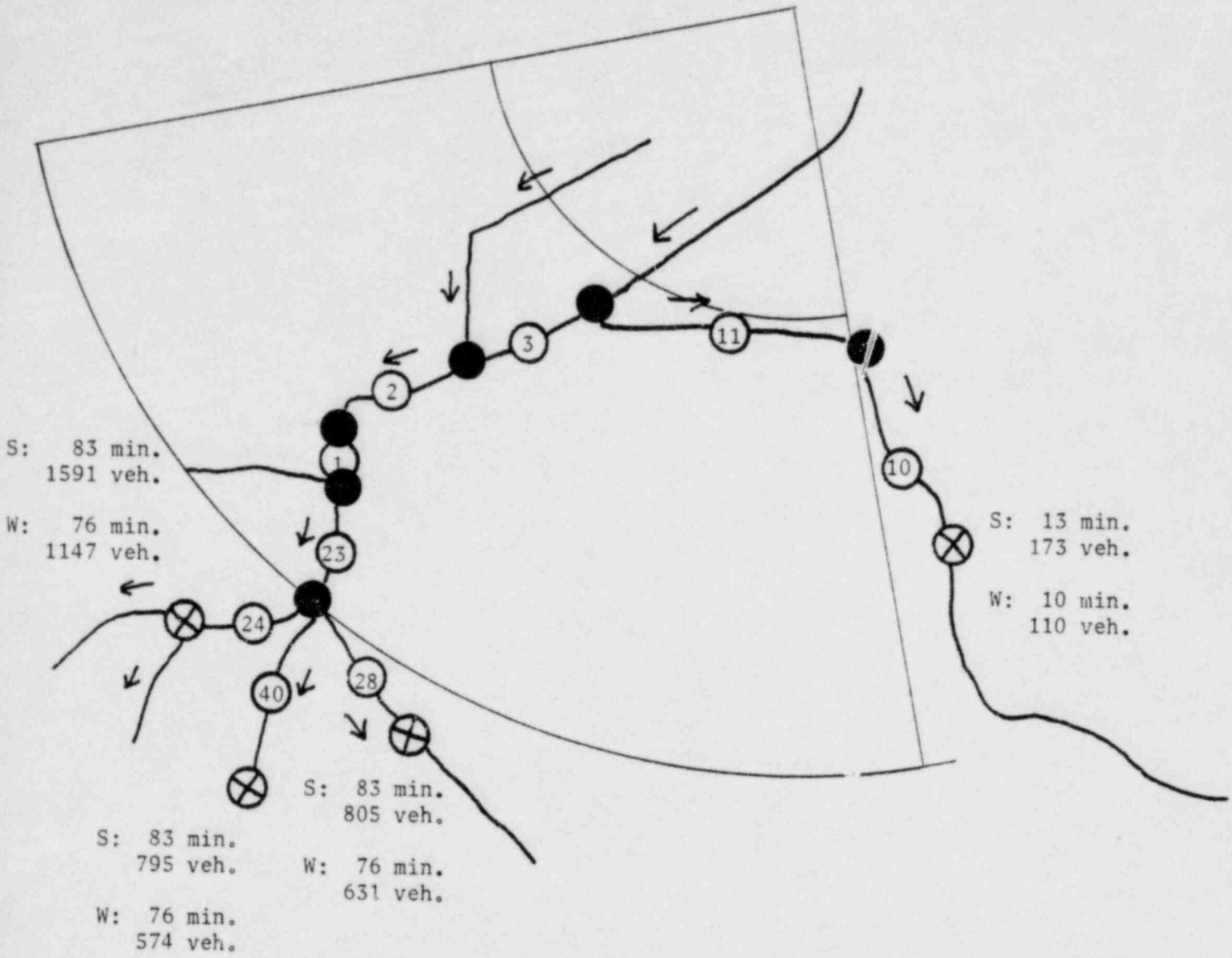

FIGURE E-2

EVACUATION ROUTINGS
ANALYSIS AREA 2 0-5 MILES

S - Summer
W - Winter

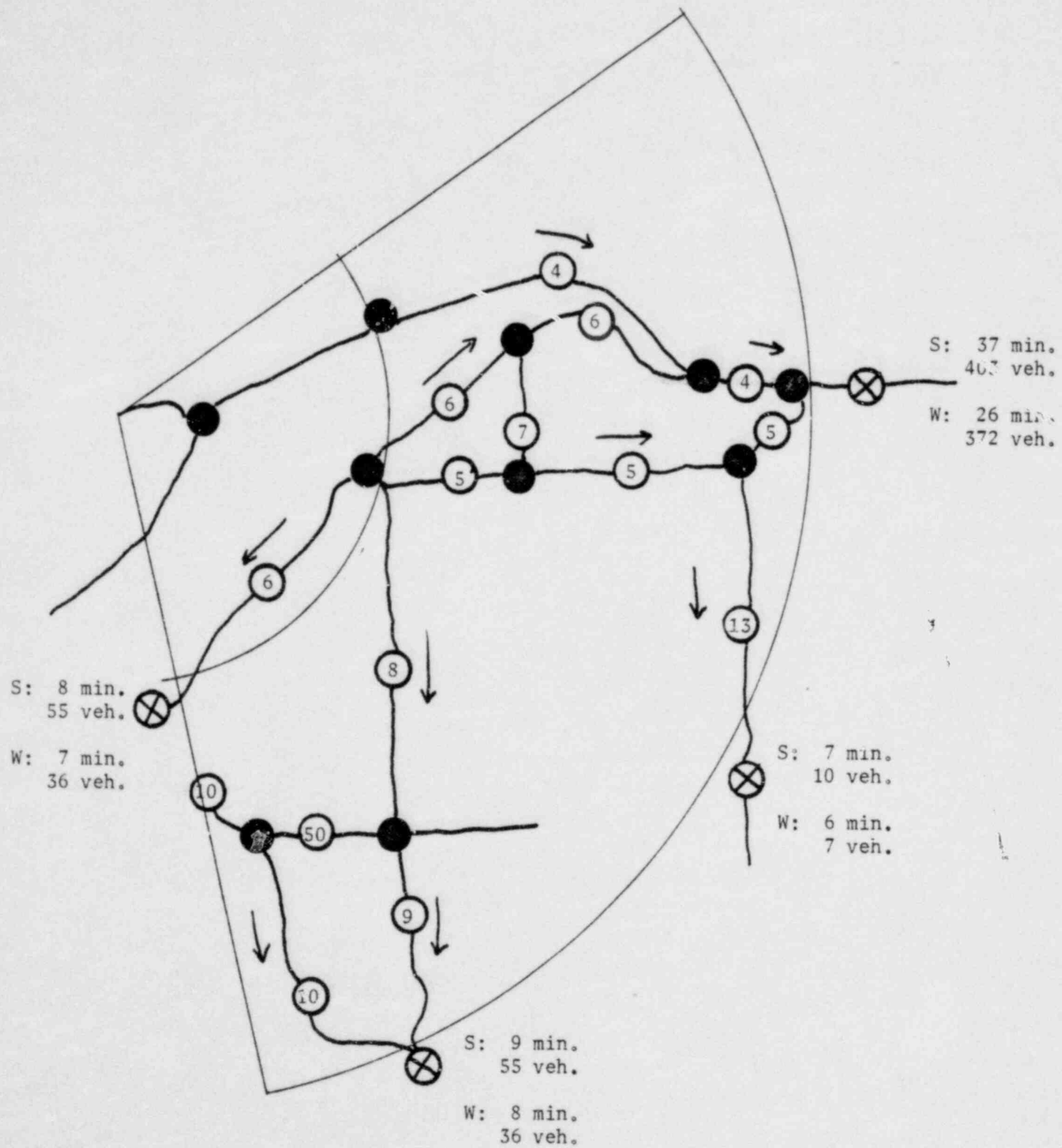

FIGURE E-3

EVACUATION ROUTINGS
ANALYSIS AREA 3 0-5 MILES

S - Summer
W - Winter

APPENDIX F

CHALEVOIX COUNTY COMPREHENSIVE PLAN

General Characteristics

Perhaps the major population trend which bears identification is the level of in-migration being experienced. Data from the Michigan Department of Public Health indicates that between 1960 and 1970, over 62% of the county's growth was attributable to in-migration.

While the above figure only represents 1943 persons in a decade, the impact of these newcomers is definite. Often times, the new residents enter the county expecting to play a role in its evolution. In some cases, this conflicts with existing political situations. This trait, perhaps above all other trends, will have a growing influence on decisions made throughout the county.

Another general category which bears examination is the distribution of population between urban and rural settings. In past years, the population comprising Charlevoix County has been generally grouped in small enclaves, villages or cities. Many maps of the county still illustrate the names of such bygone communities as Barnard, Burgess, Springvale, Coles Mill and Phelps. This trend is still evident in the unincorporated villages of Norwood, Clarion, Walloon Lake, Ironton, Horton Bay, and Bay Shore, and in the incorporated settlements of Boyne City, Boyne Falls, Charlevoix, and East Jordan.

An examination of the population as delineated by the Census of 1970 shows that the County still maintains a basically urban population distribution. At that time 8,876 persons, or 53.7% of the county's population, resided in the four incorporated communities. At the same time, many of the persons residing in the rural areas were living in the unincorporated villages listed above.

This distribution indicates that Charlevoix County has a basically balanced population distribution. The national and state levels of distribution are substantially different. For example, the United States has approximately 76.8% of its population living in communities of one thousand persons or more. The State of Michigan follows this trend by having 76.7% of its population residing in communities of a similar size. Charlevoix County is basically a rural oriented community, even though the incorporated subdivisions are beginning to exhibit urban characteristics.

All communities, incorporated units or settlements, will begin to experience increased numbers of urban problems in future years. These situations will range from increasing crime, to the need for more and better library facilities. They all have in common an increased need for public awareness of future developments and planning to meet these ultimate needs.

As these problems develop, the urban centers will become less attractive as locations for new homes. When this occurs, increased pressures will evolve in the surrounding suburban areas, and it may be necessary for some of the township units to develop quasi-municipal services. In some cases this is already occurring. It is likely to increase in frequency.

The two above noted trends help comprise the "personality" of Charlevoix County. These factors must continually be considered when evaluating future sections of this document. Additional characteristics will be pointed out through evaluation of the tables which follow.

Age, by Sex, 1970:

Table I compares the percent distribution of persons by age, by sex, as depicted in the 1970 Census of Population. The political entities that are compared are the three major cities, Charlevoix County, and the State of Michigan.

A point of significance illustrated on this table is found in the distribution of persons 60 years of age or older. Simple addition reveals that the three cities and county have a grouping of senior citizens representing between 15.5 and 17.1 percent of their population. The State of Michigan figure for this age bracket is 12.3 percent, indicating a significant overbalance of senior citizens residing in Charlevoix County.

Compensation for this overbalance in elderly persons is spotty throughout the rest of the chart. In Boyne City and Charlevoix, for example, there is a lesser percent of persons under 5 years of age than throughout the state. By the same token, in the 35 to 40 age grouping, East Jordan portrays a lesser percentage distribution than the state.

The explanation for this population characteristic is that a number of persons have chosen Charlevoix County as a place to retire. This is significant to this study, as the Comprehensive Plan must recognize the needs of this population group. Such areas of concern as senior citizen housing, recreation for the elderly, and school planning must be given particular attention.

Households, 1960 and 1970:

The average family size and the number of households located throughout the different political units within Charlevoix County is illustrated by Table IV. This chart compares 1960 and 1970 information taken from the Census of Population.

Of most significance on the following table is the fact that eleven of the nineteen political units in the county saw a decreased family size between 1960 and 1970. This ranged from .03 to 1.05 persons per household. The county average decreased by .10.

Most of the units within the county compare with the State of Michigan averages. Notable exceptions are the townships of Bay (3.62), Hudson (4.29), Marion (3.62), Melrose (3.76), Norwood (3.65), Peaine (3.63), St. James (3.71), and Wilson (3.55). Hudson Township has the highest number of persons per household in Charlevoix County.

TABLE IV

HOUSEHOLDS, 1960 and 1970

Political Unit	1960 Population	1960 Households	1960 Persons/ HH	1970 Population	1970 Households	1970 Persons/ HH
Townships						
Bay	348	94	3.70	456	126	3.62
Boyne Valley	688	204	3.37	832	258	3.22
Chandler	113	26	4.35	89	27	3.30
Charlevoix	290	82	3.54	720	221	3.26
Evangeline	420	113	3.72	440	139	3.17
Eveline	602	176	3.42	837	270	3.10
Hayes	499	140	3.56	706	211	3.35
Hudson	162	38	4.26	219	51	4.29
Marion	516	133	3.88	687	190	3.62
Melrose	672	182	3.69	830	221	3.76
Norwood	243	74	3.28	325	89	3.65
Peaine	34	15	2.27	58	16	3.63
St. James	177	48	3.69	156	42	3.71
South Arm	726	199	3.65	934	296	3.16
Wilson	464	133	3.49	650	183	3.55
Cities						
Boyne City	2,797	856	3.27	2,969	916	3.24
Charlevoix	2,751	890	3.09	3,519	1,108	3.09
East Jordan	1,919	586	3.27	2,041	628	3.20
County	13,427	3,989	3.37	16,541	5,002	3.27
State (millions)				8.875	2.653	3.27

Source: 1960 and 1970 Census of Population.

Population Growth Trends

Throughout history, human beings have tended to cluster into neighborhood groups. These groups formed to promulgate a culture and to share population similarities. A comparable situation exists in the multitude of subdivisions developed around the major urban centers throughout the United States.

Charlevoix County does not have densely populated subdivisions akin to those surrounding Detroit, but it is possible to determine certain broad based areas of influence. These are generally structured around school district boundaries, commercial service centers, employment locations, and recreation facilities. Certain natural barriers have assisted in the formulation of these areas.

The following discussions will recognize six communities within Charlevoix County. For ease of statistical comparison the boundaries were drawn using township lines. This does not assume that townships are not influenced by two or more neighborhoods. It does, however, provide the best method of analysis and evaluation.

A basic concept to be applied in using this areawide evaluation is that it makes more sense to examine a district exhibiting similar characteristics than analyzing small political units which can be affected by the in-migration or loss of a single industry. For example, the City of Charlevoix may be projected to reach a given level of population by 1990. This method of area assessment anticipates that a certain portion of this population will "spill over" into the surrounding townships. Therefore, the "area population total" is more realistic than the figures for individual political units.

Local Growth Trends, 1940-1970, by Areas:

Table VIII presents a thirty year look at the population of the political units making up Charlevoix County. Following the procedure outlined above, these political units have been grouped into areas of influence.

Area one, comprised of the two townships on Beaver Island, has witnessed perhaps the most unique growth trend. In this case development has taken a negative direction, with the population dropping a total of 302 persons (138%) since 1940.

The reason for this decrease is mainly due to the changing nature of employment on the island. During the earlier portions of this century, fishing and lumbering were important industries. Since that time, they have diminished in importance, causing the reduction in population.

The second area contains the largest populated community in the county. The City of Charlevoix serves as a focal point for a four township neighborhood.

This population grouping witnessed constant growth since the 1940s. Select units experienced a decrease between 1940-50 and 1950-60, but the area increased each decade.

Explanations for this growth rate are many; the most likely being Charlevoix's ideal location on the shores of both Lake Michigan and Lake Charlevoix. In recent years, the use of Lake Michigan for recreational and scenic purposes has increased, and a number of persons have determined that the Charlevoix area is ideal for both.

Another possible explanation for the growth in the Charlevoix area is the fact that the city serves as the county seat. As county government has grown, the number of job opportunities in the county offices has caused the city's population to increase.

A third area of influence is the largest in the county. This includes Boyne City, the five townships surrounding the city, and the Village of Boyne Falls. Growth in this area since 1940 has been sporatic.

The nucleus of this development area is Boyne City. In 1940, Boyne City contained only 65 fewer persons than in 1970. The city's high point was reached in 1950, when the population reached 3,028 persons. The 1960 Census of Population saw this drop to 2,790 persons, a decrease of 7.6 percent.

While this trend was occuring in Boyne City, the surrounding townships were experiencing steady growth increases. Since 1940, Bay, Evangeline, and Eveline Townships have experienced growth each decade. Boyne Valley Township diminished in population from 1940 to 1950, but, since that time, the township has grown steadily. Wilson Township is the only political unit which decreased from 1940 until 1960. This loss was recovered with a 40.1% rate of growth from 1960 to 1970.

Explanations for this trend in growth are vague. It is likely that a number of influences were involved. Such things as the development and maturity of the skiing industry, the attitude of local officials toward industrial development, the location of the Boyne City harbor eighteen miles east of Lake Michigan, the availability of public, commercial, or service job opportunities, and the slow development of the area as a shopping center. Each of these factors has impacted the area's growth.

Area 4 is comprised of the City of East Jordan and South Arm Township. It is influenced by Banks, Central Lake, and Echo Townships in Antrim County. While the population of the out-of-county political units is not shown, their influence and past growth trends were used in determining a growth trend for this area.

The East Jordan community has experienced slow, but steady, growth since 1940. This is basically a single industry environment and as this major enterprise expanded in the past, so grew the area. With an influx of additional industrial concerns, and related commercial and service developments, the community is influenced by more factors.

While East Jordan has experienced a steady increase in population since 1940, South Arm Township has witnessed a fluctuating population level. This apparently has bottomed out, and is now heading in an upward direction, as the township realizes population "spill over" from the city.

The Walloon Lake area is comprised of Chandler and Melrose Townships, and is influenced by Resort, Bear Creek, and Springvale Townships and the City of Petoskey in Emmet County. This is a rural area, with the orientation of residents divided between Petoskey, Boyne City, and Vanderbilt (Otsego County).

Most residents of this portion of Charlevoix County have their places of employment in the surrounding area. These two townships serve as suburban habitats. The Village of Walloon Lake, an unincorporated settlement near the middle of Melrose Township, functions as a "neighborhood" commercial center.

TABLE VIII

LOCAL POPULATION TRENDS

1940-1970, by Areas

AREA	1940	1950	PERCENT CHANGE	1960	PERCENT CHANGE	1970	PERCENT CHANGE
1. Beaver Island							
Peaine Twp.	175	99	-43.4	48	-51.5	58	20.8
St. James Twp.	346	297	-14.2	169	-45.1	161	- 1.2
Total	521	396	-31.[illegible]	217	-82.5	219	0.9
2. Charlevoix							
City of Charlevoix	2299	2695	17.2	2751	2.1	3519	27.9
Charlevoix Twp.	167	183	9.6	290	58.5	720	148.3
Hayes Twp.	702	556	-20.8	499	-10.3	706	41.5
Marion Twp.	523	504	- 3.6	516	2.4	694	34.5
Norwood Twp.	260	255	- 1.9	243	- 4.7	325	33.7
Total	3951	4193	6.1	4299	2.5	5964	38.7
3. Boyne City							
City of Boyne City	2904	3028	[illegible]	2797	- 7.6	2969	6.1
Bay Township	320	344	7.5	348	1.2	456	31.0
Boyne Valley Twp.	677	628	-15.5	688	9.2	832	13.3
Evangeline Twp.	271	313	15.5	420	34.2	446	4.8
Eveline Twp.	533	553	3.8	602	8.9	837	39.0
Wilson Twp.	528	503	- 4.7	464	- 7.8	650	40.1
Total	5233	5369	2.6	5319	- 0.9	6190	16.4
4. East Jordan							
City of East Jordan	1725	1779	3.1	1919	7.9	2041	6.4
South Arm Twp.	707	760	7.4	726	- 4.5	995	37.1
Total	2432	2539	4.4	2645	4.2	3036	14.8
5. Walloon Lake							
Chandler Twp.	129	144	11.6	113	-21.5	89	-21.2
Melrose Twp.	556	635	14.2	672	5.8	830	23.5
Total	685	779	13.7	885	13.6	919	3.8
6. Hudson							
Hudson Twp.	209	199	- 4.8	162	-18.6	219	35.2
Total	13,031	13,475	3.4	13,427	- 0.4	16,541	23.2

Source: US Census of Population

Since 1940, Chandler Township has decreased in population by almost 50 percent; while, Melrose Township has increased by a like percentage. This trend can be explained by noting Melrose Township's location along heavily travelled U.S. 131, and the relatively isolated location of Chandler Township.

A final area is comprised of Hudson Township. This unit stands alone, as the persons living here generally orient their work, school, and play patterns to the villages of Elmira and Vanderbilt in Otsego County.

As can be seen from the accompanying table, this township has experienced an erratic growth trend since 1940, with the 1970 population only 10 persons above that tallied at that time. The 35.2 percent increase from 1960 to 1970 is similar to that in the townships and villages in the surrounding area.

The population profile of these six areas, when viewed as a county, shows a decreasing growth rate from 1940 to 1960. During the decade of the 1960s, the county increased by 23.2 percent. This expansion is reflective of the factors pointed out above.

This evaluation of the county's growth trend since 1940 forms a basic background for understanding the future in terms of population.

Estimated Seasonal Population, By Areas:

A discussion of seasonal populations in Charlevoix County is highly important, as the influx of temporary individuals causes a notable change in the community during peak resort periods of the year. A clarification of the difference between seasonal and transient residents will be used to introduce this analysis.

Seasonal residents, as defined for purposes of this report, includes those persons who reside on a part time basis in a dwelling unit located within the confines of Charlevoix County. The dwelling units referred to are normally called second homes or seasonal homes.

Transients, on the other hand, are residents of the county for short periods of time, normally utilizing a motel room, hotel room, cabin, campsite, or similar dwelling place while visiting the county. This includes those persons who stay outside of the county and visit on a day-by-day basis.

It is difficult to project the number of transient visitors to the county. However, given the many attractors for transient visitors - Youngs State Park, Whiting County Park, Boyne Mountain Ski Resort, Thunder Mountain Ski Resort, Walloon Hills Ski Resort, numerous city and township parks and beaches on Lake Michigan, Lake Charlevoix, and Walloon Lake, Bells Bay State Forest Campground, and dozens of public access sites - it is possible to make a "ball-park" estimate of 8,000 to 10,000 persons on a given high use day.

The estimation of the seasonal population is somewhat more scientific. This is done utilizing the 1970 Census of Housing and the 1972-73 Housing Survey undertaken by the County Planning Department. Table IX depicts the estimated seasonal populations by area.

Assignment of a family size of 3.5 persons is undertaken following an assumption that the resort family typically will contain from 1 to 2 children. Larger families are counterbalanced in the system by childless elderly families and single individuals.

TABLE IX

ESTIMATED SEASONAL POPULATION

By Areas

AREA	DWELLING UNITS	AVERAGE FAMILY SIZE	SEASONAL POPULATION	TOTAL POPULATION[3]
1. Beaver Island				
Peaine Township	132[2]	3.5 persons	462	520
St. James Township	101[2]		353	514
Total	233		815	1034
2. Charlevoix				
City of Charlevoix	333[2]	3.5 persons	1,166	4,685
Charlevoix Township	104[2]		364	1,084
Hayes Township	102[1]		357	1,063
Marion Township	29[1]		102	796
Norwood Township	35[1]		123	448
Total	603		2,112	8,076
3. Boyne City				
City of Boyne City	141[2]	3.5 persons	494	3,463
Bay Township	169[1]		592	1,048
Boyne Valley Township	48[1]		168	1,000
Evangeline Township	80[1]		280	726
Eveline Township	355[1]		1,243	2,080
Wilson Township	47[2]		165	81
Total	840		2,942	9,132
4. East Jordan				
City of East Jordan	80[2]	3.5 persons	280	2,321
South Arm Township	166[1]		581	1,576
Total	246		861	3,897
5. Walloon Lake				
Chandler Township	14[1]	3.5 persons	49	138
Melrose Township	246[1]		861	1,691
Total	260		910	1,829
6. Hudson				
Hudson Township	148[1]	3.5 persons	518	737
Total	2,330		8,158	24,699

[1] 1972-73 Housing Survey, Charlevoix County Planning Department.

[2] 1970 Census of Housing.

[3] Includes year-round and seasonal. Year-round populations taken from Table VIII.

This table illustrates that the largest number of seasonal residents occupy temporary dwelling units in the Boyne City area. The Charlevoix area is close behind, followed then by the Walloon Lake, the East Jordan, the Beaver Island and the Hudson areas. Taken together, a seasonal population of approximately 8,158 persons resides in the second home units in the county.

As these are actual figures, it is significant to locate major settlements of seasonal residents. Eveline Township, with 25 miles of Lake Charlevoix shoreline has an estimated seasonal population of 1243, 48.6 percent more than their year-round population. Other townships experiencing this phenomenon are: Peaine (696.5%), St. James (123%), Bay (30%), Melrose (3.7%), and Hudson (137%). South Arm and Hayes Townships and the City of Charlevoix also contain large seasonal populations.

The final column on Table IX depicts the total year-round and seasonal population by particular units and influence areas. This tabulation presents a more definitive look at the population of Charlevoix County. The addition of the eight thousand plus estimated seasonal residents adds a new dimension to the plan "foundation" which will evolve from this study of the county population.

Projected Populations, 1980-90, by Areas:

Following the above evaluation of past trends and the current status of the population of Charlevoix County, an estimate of the 1980 and 1990 population is presented. Two projections are provided for each political unit. These are based on forecasts undertaken by the Department of Commerce, State of Michigan, and the Charlevoix County Planning Department (Solid Waste Management Plan, 1974).

Both projections shown on Table X were based on impacts such as automobile registration trends, voter lists, birth and death rates, and similar growth determinants. The Department of Commerce projection is wholly a statistical projection while the Planning Department estimate attempts to measure the pulse of development in the areas covered by the projections.

Area 1, covering Beaver Island, is expected to grow slightly by 1980, and again slightly by 1990. The total population in 1990 is projected to be 53.8 percent higher than the current level; however, even with this increase, the island group will not approach the population level of the early century.

Growth in the Beaver Island area will be attributable to an increase in development of resort oriented service facilities of both a winter and summer type. This will yield an increased seasonal population which will support more year-round residents.

The second area on Table X is the Charlevoix area. Population increases here are expected to occur as a continuation of the trends which developed during the decade between 1960 and 1970.

Extension of the rate of growth experienced during the 1960's assumes that the conditions causing the increase will continue to impact this area. Indicators available at the time of this report's preparation (1975), support this premise.

TABLE X

PROJECTED POPULATION

1980-90, by Areas

Area	1980				1990			
	1	2	Seasonal	Total	1	2	Seasonal	Total
1. Beaver Island Townships								
.Peaine	70	73	578	648	84	91	723	807
.St. James	193	234	449	642	232	333	561	793
TOTAL	263	307	1,027	1,290	316	424	1,284	1,600
2. Charlevoix City								
.Charlevoix	4,927	3,859	1,458	6,385	6,898	4,230	1,823	8,721
Townships								
.Charlevoix	1,008	1,379	455	1,463	1,411	2,632	569	1,980
.Hayes	988	1,011	446	1,434	1,383	1,446	558	1,941
.Marion	972	936	128	1,100	1,361	1,260	160	1,521
.Norwood	455	432	154	609	637	574	193	830
TOTAL	8,350	7,617	2,641	10,991	11,690	10,142	3,303	14,993
3. Boyne City City								
.Boyne City	3,711	4,337	618	4,329	4,639	6,327	773	5,412
Townships								
.Bay	570	620	741	1,311	713	842	926	1,639
.Boyne Valley	1,040	1,263	210	1,250	1,300	1,915	263	1,563
.Evangeline	550	806	350	900	688	1,553	438	1,126
.Eveline	1,046	1,145	1,554	2,600	1,308	1,564	1,943	3,251
.Wilson	813	861	206	1,019	1,016	1,141	257	1,273
TOTAL	7,730	9,032	3,679	11,409	9,664	13,342	4,600	14,264
4. East Jordan City								
.East Jordan	2,347	2,439	350	2,697	2,699	2,915	438	3,137
Township								
.South Arm	1,144	1,497	726	1,870	1,316	2,249	908	2,224
TOTAL	3,491	3,936	1,076	4,467	4,015	5,164	1,346	5,361
5. Walloon Lake Townships								
.Chandler	120	121	61	181	162	158	76	238
.Melrose	1,121	1,117	1,076	2,197	1,513	1,502	1,345	2,858
TOTAL	1,241	1,238	1,137	2,378	1,675	1,660	1,421	3,096
6. Hudson Township								
.Hudson	283	302	648	933	371	414	810	1,181
TOTAL	21,360	22,432	10,362	31,722	27,731	31,146	12,764	40,495

1 Planning Department, Charlevoix County
2 Department of Commerce, State of Michigan

Projected populations in Area 3 show Boyne City to be a growth area for the next decade and a half. Both the Planning Department and the Department of Commerce figures support this expansion of the Boyne City influence area. The state projection goes so far as to indicate an increase for Boyne City of 113.1 percent over the 1970 population.

Growth projections of this magnitude are based on the many potentials for development in the Boyne City area. Continued proliferation of the skiing industry; and increased demand for homesites with a "view" of Lake Charlevoix, Walloon Lake or the various ski resorts; steady industrial development (augmented by an expressway to be built into northwestern Michigan sometime in the 1980's); and the evolvement of Boyne City as a major commercial service center, all will contribute to an increase in population in this area.

The East Jordan area is estimated to develop at a lower rate of growth than the areas influenced by the two other cities. Many reasons exist for this projection level. The most compelling seems to be the dominance of the East Jordan Iron Works industrial location. The plant is situated at the hub of activity in the city and tends to influence the growth attitude of the surrounding area.

This is not to say that the manufacturing site is obnoxious; however, when an industry so dominates a setting, the focus of the community attitudes tend to follow that lead. This, in turn, sets the standard for lifestyles in the area.

It also influences community growth decision making. Because of this, East Jordan has developed as a primary industrial location in Charlevoix County. This, however, conflicts with the evolvement of "tourist" oriented activities, and, whereas, Boyne City, Charlevoix, Petoskey, Harbor Springs, and other surrounding communities have experienced continuous resort development, East Jordan has grown slower due to its "industrial" image.

Actually, with the potential for an expressway to provide better transportation to and from the East Jordan area, it is possible to assign a larger growth percentage here. The estimate on Table X reflects this possibility, however, it assumes a slower, more deliberate rate of expansion for East Jordan.

Both the Planning Department and the Department of Commerce agree that the Walloon Lake area will experience substantial growth in the next two decades. The influence of Petoskey and Boyne City, and, to a lesser extent, Vanderbilt, will support the 69.3 percent increase in total population (year-round and seasonal) by 1990.

Area 6 has already been described as overlapping into Otsego County in its orientation. Hudson Township is projected to be the recipient of much of the growth of that area.

Table X projects both an increase in the seasonal and year-round population of the area within the confines of the township. This is supported by proposed developments on Thumb Lake (Lake Louise) and Bows Lake and by increased requests for permits to build rural homesites within the township.

Taken together, with the unique circumstances affecting each of the areas described above, Charlevoix County is slated to witness an expansion of its year-round, seasonal, and total population levels. Future plan considerations must reflect the increases of 67.7% (Planning Department figures), 56.3%, and 63.9%, respectively, for these population categories.

APPENDIX G

EOC ACTIVATION ALERT LIST

EOC Staff List for a Nuclear Power Plant Incident
(for 24-hour operation)

EOC POSITION	NORMAL POSITION	BACK-UP POSITION
Executive Group		
Chief Executive	Chairman, Board of Commissioners	Vice-Chairman
Chief of Staff	Emergency Services Coordinator	Deputy Coordinator
Public Information Officer	Reporter, Charlevoix Courier	Reporter, Charlevoix Courier
Damage Assessment Group		
Damage Assessment Group Chief	Director, Equalization Department	Assistant Director, Equalization Dept.
Damage Analysis Officer	Assistant Director, Equalization Dept.	Appraiser I
Damage Assessment Team	Appraisers	Appraisers
Plotter	Appraiser I	Appraiser I
Radiological Defense Officer	Planning Department Director	Teacher, Boyne City High School
Operations Group		
Police Operations Officer	Sheriff	Under Sheriff
Fire Operations Officer	Designee (from Boyne City)	Designee (Chief, Charlevoix City)
Welfare Operations Officer	Director, Department of Social Serv.	Special Services Coordinator, Dept. of Social Services
Public Works Operations Officer	Road Commission Engineer	Road Commission Foreman in Charlevoix area
Health Operations Officer	Administrator, Health Dept., Dist. 3	Environmental Health Div. Director
School Support Operations Off.	Superintendent, Intermediate Schools	Assistant Superintendent
Resource Group		
Communications Officer	Dispatcher	Dispatcher
Controller/Log Recorder	Posse	Posse
Plotter	Appraiser I	Appraiser I
Messenger	Posse	County Secretary
State Liaison	MSP Emergency Services Field Coord.	Lt., Community Services
Consumers Power Company Representative (in County EOC)	[illegible]	[illegible]
Liaison to State EOC (the county representative who will be present at the State EOC)	Commissioner, District 6	Commissioner, District 3

Attachment 3 to Appendix 1 to the Direction and Control Annex

EOC STAFF TELEPHONE NUMBERS*

EOC Position	Name	Office	Home
Chief Executive	Clyde Cunningham	547-2088	547-2088
Emergency Services Coordinator	Earl Muma	547-6087	547-9658
Public Information Officer	Dennis Chase	547-6558	547-2657
Damage Assessment Group Chief	Joan Blanchard	547-9919	547-6602
Radiological Defense Officer	John Hess	547-4292	547-4245
Law Enforcement Operations Officer	Sheriff Lasater	547-4461	582-7747
Fire Operations Officer	~~Louis Schomberger~~ Dick Barnet	~~582-6611~~ or ~~582-6541~~	~~582-9813~~
Social Services Operations Officer	Richard Tillen	547-4471	547-6440
Public Works Operations Officer	Fred Welch	582-7330	582-2465
Health Operations Officer	Jerry Chase	547-6523	547-5147
School Support Operations Officer	Jim Shepherd	547-9947	536-7679
Controller			
Messenger			
Log Recorder (dispatcher)			
State Liaison	Sgt. Jim Tyler	1-946-0550	1-946-4646
Consumers Power Liaison			
County Liaison to State on-scene EOC	Larry Matthew, Comm., District 6	none	535-2317
County Liaison to Plant's EOC	~~Drake~~ Orvie Sutliff, Comm., District 11	none	582-9194

*Note: Back-up EOC staff telephone numbers in Attachment 4.

Attachment 4 to Appendix 1 to the Direction and Control Annex

BACK-UP EOC STAFF TELEPHONE NUMBERS*

EOC Position	Name	Office	Home
Chief Executive	Donald Meggison	547-6581	547-6444
Emergency Services Coordinator	Alice Tunison	N/A	547-6054
Public Information Officer	Peg Olhe	547-6558	
Damage Assessment Group Chief	Carla Spencer	547-9919	547-6725
Radiological Defense Officer	Henry Lentz		
Law Enforcement Operations Officer	Bryon Stockwell	547-4461	547-9813
Fire Operations Officer	John Curtis	547-6611	547-2873
Social Services Operations Officer	Doug McCombs	547-4471	547-6042
Public Works Operations Officer	Dick Stangis	582-7330	547-6174
Health Operations Officer	Dean Mikulski	547-6523	547-9054
School Support Operations Officer	Sue Shepherd	547-9947	347-1389
Controller			
Messenger			
Log Recorder (dispatcher)			
State Liaison	Lt. Robert Beadle (Community Services District Coordinator)	1-946-0550	
Consumers Power Liaison	to be designated		
County Liaison to State on-scene EOC	Ralf Harmon, Comm., District 7		549-2630
County Liaison to Plant's EOC	Casimer Toton, Comm., District 10		582-6862

*Note: Primary EOC staff telephone numbers are located in Attachment 3. These people should be called first. If they cannot be reached, this back-up list should be used.

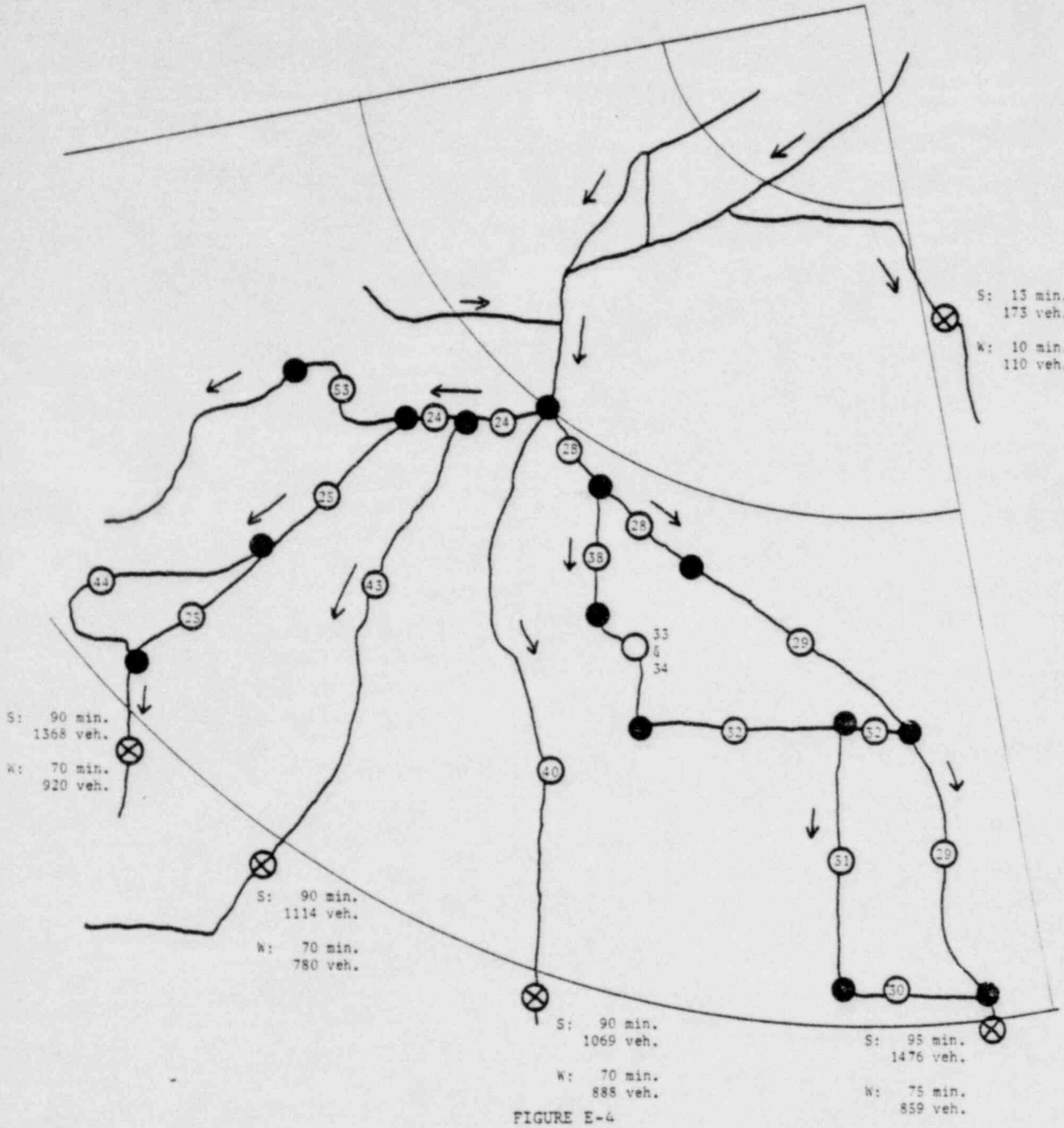

FIGURE E-4

EVACUATION ROUTINGS
ANALYSIS AREA 4 0-10 MILES

S - Summer
W - Winter

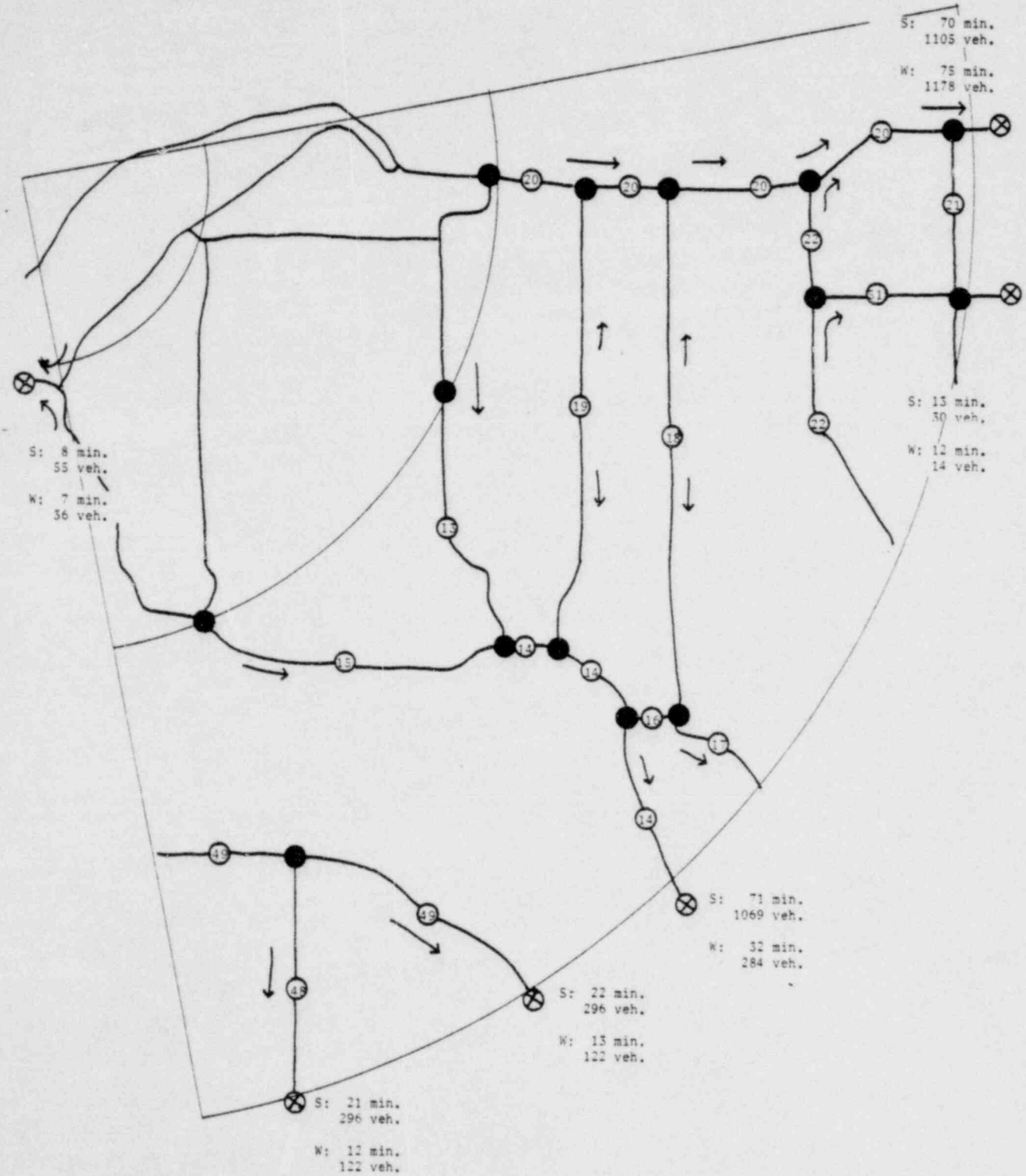

FIGURE E-5

EVACUATION ROUTINGS
ANALYSIS AREA 5 0-10 MILES

S - Summer
W - Winter